HYGIENE OF

Town Planning and Vegetation.

By

P. S. G. DUBASH, D.Sc.,

Dr. es. Sc. Sanitaire, D. Chrom. etc.

With Introduction by

Hon. Sir John A. Cockburn, K.C.M.G., M.D.

3/-

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With Introduction by

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DEDICATION

To

CHARLES HYATT-WOOLF, ESQ., F.R.L.S., F.R.P.S., Etc.,

The Editor of *Popular Science Siftings*,

123-125, Fleet Street, London, E.C.4.

Dear Sir,

This book is inscribed to you as a trifling token of my appreciation, nay admiration, for your prolonged and successful efforts to

(1) Popularise Science among the English speaking people, of which the British are benefited the most, as there was an enormous amount of work to be done among them.

(2) Maintain a fight—at times an almost thankless one—for the genuineness of patent articles and advertisements.

(3) Face the odds in insisting that the public must be supplied with as pure foods as possible, and reduce the amount of harmful preservatives in food stuffs.

(4) Encourage independent investigations and observation by agreeing to undertake the publication of my scheme known as "The Experimentor Circle."

(5) Promote constructive skill and imagination by helping forward young inventors, by giving publicity to their observing contrivances, and even indicating the lines of inventions needed.

Yours very truly,

PESHOTON SORABJI GOOLBAI DUBASH.

INTRODUCTION.

All important to civilisation is the Art of Town-Planning, nevertheless no department of human activity has, in the modern world, been more neglected. Even among nomadic race some order was observed in the grouping of their habitations. The sites for the military camps of the Romans were carefully selected, and the tents were arranged according to definite rules which might well have served as models for the planning of permanent abodes. But in the haphazard fashion of civil life the early settlers took no account of anything beyond their immediate necessities. Unfortunately, the situations which presented at the outset the greatest facilities were often those which for the sake of future developments ought to have been avoided. Proximity to water supply was one of the main determining factors in selecting a site. Low-lying ground with a retentive subsoil offered in this respect a temporary convenience which had to be paid for by unsanitary conditions in future generations. Happier for posterity was the lot of the hill tribes which, for purposes of defence, were forced to fortify the uplands.

It is one of the ironies of life that knowledge often comes after the opportunities for using it have passed away. A vast field for the exercise of the art of town-planning was provided by the tendency to city crowding and the resulting

mushroom growth of centres of population which characterised the last century. Yet strange to say, never was the orderly laying-out of thoroughfares and dwellings less regarded. Even in virgin lands where site values were nominal, the course of main streets sometimes followed the sinuous tracks of the bullock-drays of pioneer settlers. The dawn of a better age, however, was witnessed in the founding of Adelaide, the capital of South Australia. This city lies four square, like the New Jerusalem, with wide and regular streets interspersed with spacious squares, and surrounded by a broad belt of park lands reserved for the health and enjoyment of future generations. Of late years the awakening of corporate consciousness in the minds of citizens has led to a recognition of the vital importance of town-planning. Garden cities and garden suburbs give evidence of this. Conferences on town-planning take place periodically in many countries. Extensive powers to control the erection of new buildings and to condemn insanitary dwellings are vested in municipal authorities. These signs of the times are a providential preparation for after-war reconstruction. Millions of our fellow-countrymen require re-housing. Hundreds of thousands of dwellings have to be erected in Great Britain and Ireland. City slums will soon be an evil dream of the past. The rack-renting landlord has himself been served with notice to quit. Never were the auspices more favourable for the issue of a book on Town-Planning. Dr. Dubash has, in the present volume, taken Time by the forelock. He is eminently fitted for the task he has undertaken. Well grounded in Sanitary Science, he brings a philosophic

mind to bear on the problems with which the world is confronted. During his sojourn in England and in the Western Hemisphere he has buttressed with sure methods of induction the powers of introspection and *a priori* reasoning of Eastern culture which are his birthrights. Dr. Dubash deals primarily with town-planning as it affects the health and well-being of the workers. Undoubtedly this is the just way to approach the subject, for the workers constitute the body of the nation, while the privileged classes, even if they perform their proper function, are merely, as it were, the special senses of the community, and are subsidiary to the welfare of the body as a whole. While the Author lays especial emphasis on the necessity of sanitary conditions, he is not unmindful of æsthetic considerations, and devotes much space to the advantages of tree-planting. Belts of trees are objects both of utility and beauty; they provide shelter from stormy winds without impeding the through current of air which is so essential for health-giving ventilation. One s reminded in this connection of the achievement of Empedocles in Ancient Greece, who, by boring through a rock, opened an air-way in his native city, and thus restored the population to health. Not only are subsoil and surface drainage essential, but attention has recently been paid to the virtue of atmospheric drainage. An elevation with a gentle declivity permits mists and heavy vapours to escape by the action of gravity. Subsoil, water, ground air, soil bacteria, and soil temperature are effectively dealt with in their relation to public health. The evils of over-crowding, both from the sanitary and the moral point of view, are strongly emphaissed. It has

been well said that it is more humane to rely on sanitation than on the death-rate to solve the problems of over-crowding.

The details of house-planning naturally receive much attention in these pages, as also do the laying out and construction of streets, gardens, and open spaces. A special feature is made of vegetation in relation to town-planning. A vast amount of valuable information on this subject is presented in an attractive and interesting manner. The action of vegetation on water supply. Its influence on climate and atmosphere and on health in general here receive the attention they so amply merit. The lovers of trees will be gratified by the testimony adduced as to their incalculable value. The medicinal virtues of the aromatic fragrance of trees and shrubs yielding essential oils is clearly demonstrated. The influence of the Eucalyptus in lessening malaria is undeniable. The measures which have been successfully employed in coping with malarial infection are well summed up. The work constitutes a valuable contribution to the Science and Art of Town-Planning, and is especially welcome at a time when the minds of all men are directed to the subject as one of the most pressing needs of the age.

JOHN A. COCKBURN.

PREFACE.

My very kind friend, the Hon. Sir John A. Cockburn, has said all that need be said about introducing the subject matter of this booklet, but here I only add that the aims of this book are—

(1) To offer a very concise book on this subject to save the time of students of sanitation and hygiene, and also of municipal corporations who want to know something about the subject.

(2) To be as precise as possible and give only the best opinions on various aspects that are treated here, without offering any original suggestions, so that it can be a text-book of well-established facts all cut and dried and put in a nut-shell.

Let me add that the various qualifications after the name of the Hon. Sir John Cockburn are put by me, and yet I find that I have omitted very many of very great importance.

Yours faithfully,

P. S. Q. DUBASH.

Part I. Town Planning.

PRELIMINARY.

The general practice in dealing with the question of town-planning is to consider either solely or mostly the housing of the workers. Though this is indeed the most important question, yet it appears that other matters bearing directly upon the planning of towns and the health of the public are quite relevant to the subject, if treated from this specialistic point of view. As towns are to be planned on the soil, some attention must be paid to the soil and its relation to health. It is proved beyond doubt that soil has something to do with health, even though sanitarians have not been able to arrive at absolutely discriminative conclusions. Most people have heard of malarious soils. This is quite enough to prove the relation existing between soil and health.

Sanitation is very modern and towns are very ancient, and so it is easy to see that on the whole there has not been much town-planning. Towns have grown up haphazard as population increased, before the science of sanitation was known. The pressure of population, almost in the same way as osmotic pressure, produces an expansion from the centre outwards. This naturally leads to the habitation of the suburban districts of a town. Suburban districts of a town are country districts. It is in these districts that there is

the opportunity for real planning, that is, arranging houses and roads in accordance with the rules of attaining good health for the inhabiting community. So town-planning is in reality country-planning. Yet in towns themselves, the old streets are to be renewed, the insanitary buildings to be demolished, and sometimes even new streets are to be made, all of which does not give much liberty for free planning. It is quite necessary that the sanitation of the country districts should be attended to, for the simple reason that there is a direct communication between the urban and rural district, and so it is absurd on the face of it to suggest that one can be made quite healthy without attention to the other.

This becomes more apparent when we see that the summer resorts on hills or by the sea often cause sickness, that the natural waterways often get contaminated by the neglect or abuse of the rural inhabitants, and that more typhoid is actually found in many rural districts than even in large metropolises. Thus careful planning and sanitation are needed for suburban and country districts. When housing provision is to be made for the increasing population in the suburban districts, the selection of situation should also be made on sanitary lines. If it is possible in suburb population to avoid unhealthy situations or soils, it should be done, instead of taking after-the-event precautions of making it healthy.

SITUATIONS AND SOILS.

Good scenery is not a consideration altogether to be discarded. To remove or neglect natural, good

scenery, and then substitute for it afterwards new plantation, gardening or afforestation, is only to increase the expenses. It is cheaper to turn natural gardens into healthy gardens, instead of making new ones. The relation of sites and disease has already been presented in the paper on vital statistics, but a few facts from the health point of view will be added here. Considering the surface, a good situation is on a slight elevation which has a good surface drainage, and where on the windward side there is a protecting wood or hill. It is desirable to have a lake or a river or some stretch of water in the foreground, that is, towards east or south. All houses cannot be facing the same direction, and hence arises the difficulty of orientation, which solves the question of fixing the price of the sites. The protection from winds should not be such as would cause bad ventilation of the district. The inner side of a high mountain which very well shelters that side from wind is a bad situation. One must not select, for building a row of houses, a stretch of ground in a narrow valley, a low meadow or the north-side of a high hill. When cold winds are to be kept off artificially, a plantation of fir, spruce, pine or evergreens will be effective and picturesque. This can help to a certain extent in isolating the place from the spread of certain diseases. If a selected situation has strong westerly winds, the orientation should be more or less southernly. This, besides giving protection from winds, gives the sunshine a chance to enter the houses. If the new district to be populated is of a large size, it is found difficult to select it in accordance

with all the minor observations upon health and situation. Some parts may be bad, whilst others are good. The unfavourable parts should not be used for building dwellings unless improved by special steps, but with some precautions may be used for other purposes where people do not spend much time. Dr. Harvey B. Bashmore says, "Uncut grass, dense foliage, decaying weeds and wood will spoil the appearance and lower the sanitary condition of almost any place."

The level of the subsoil water may be very much raised in a low-lying district, like plains at the foot of hills, by a heavy rain that fell quite at a distance. As the level of subsoil water bears a relation to health, such a situation is not a desirable one unless careful precautions are taken about the construction of every building and well. Dr. S. Monckton Copeman observes, "Usually radiation takes place more rapidly than absorption, particularly where herbage is abundant, so that soils cool more rapidly than they heat." The powers of absorbing, conducting and radiating heat by soil varies according to the kind and colour of the geological formation. A warm, dry and porous soil is furnished by beds of sandstone, gravel, and shale. On account of this great porosity, such sites are very liable to be infected by water and air from neighbouring cesspools and polluted soils, etc. Clay soil is damp because it is almost impervious and has considerable absorptive powers. This becomes worse because of its low specific heat and constant evaporation. Subsoil drainage can cure these defects. Yet absorption depends more on the colour of the soil and the thickness of vegetation on it. The

darkest soil will absorb most, and therefore will be the warmest soil; so it is the soil which is the richest in humus that will be the warmest, because the colour of it on the whole is caused by the products of decomposing organic matter. Herbage may cause so much absorption that a difference of temperature as great as 30 °F. may be caused in tropical regions between a bare rock and a neighbouring one with grass on it.

The relation between soil temperature and disease was first shown by Delbruck. There are the surface soil, or "mould," and subsoil. The former may contain large quantities of organic matter. These constituents and the manner in which they are affected by varying degrees of moisture, temperature and aeration influence the health of communities abiding on them. The latter consists mostly of inorganic matters and does not directly concern the health except through deep well and spring waters. Soils are formed more or less directly from the decomposition of rocks. Denundation of clay produces clayey soils; that of sand-stone, sandy soils; when these occur together a sandy-clay soil or loam is produced.

The various rock formations may be divided into igneous and sedimentary. The igneous rocks and granite, the trap rocks including greensands, and basalt and also syenite. From the decomposition of igneous rock and re-formation of the decomposed parts the aqueous or sedimentary rocks are also called stratified rocks. Dr. Copeman theorises that the soils may absorb and condense gases after the manner of spongy platinum. It does not appear in any way advisable to go further into the pure geology of soils,

but now the geology in relation to soil and subsoil water, and moisture, ground-air, ground-temp. shall be considered.

SOIL WATER AND MOISTURE.

Ground or subsoil water is more or less a continuous sheet of water to be found within a few inches from the surface or a hundred feet or more further down. Though rainfall does not much affect the level of subsoil water and water levels in wells, yet it does so to a certain extent, the effect being visible some weeks afterwards. Yet it may produce such effects in low-lying sites as already stated. The roots of trees impede the movement of ground water. Its level at times gets raised by some stoppage in the outfall due to a water-course becoming choked up. This can happen by reason of the back-pressure of the sea. The level can be lowered by removing the obstruction or by skilfully draining the place. The level of the ground water varies with the rise and fall of level in the neighbouring rivers. Dr. Copeman says, "The variations in the layers down to about six feet below the surface especially are of most interest practically, since the upper layers naturally will be the most polluted, and, therefore processes which influence health probably go on in them to a much greater extent than in the layers below." The moisture in soils is evidently due to their obsorptive powers. Every soil is capable of absorbing a certain amount of water. One kind of loose sand is supposed to be able to hold two gallons of water in a cubic foot, while ordinary sandstone can hold one gallon. Dried quartz can retain 20% moisture; humus

40-60% and retain it strongly; moderately loose clay 20%. Dr. Copeman states that in the loosest sands more than 90% of the rainfall may penetrate the soil, while in the case of chalk it has been calculated at 42%, and with sandstone at 25% on the average, the remainder either evaporating or draining away along the surface. It is easy to see that the curve of moisture should run almost parallel to that of rainfall, while in deeper layers the curve of moisture should evidently be parallel to that representing the rise and fall of the level of the ground water. In both the cases the highest point is reached during summer and early autumn. It is found that the capacity of a soil for absorbing water is directly proportional to the amount of organic substances present. The amount of moisture does not vary much from four to six feet of depth.

GROUND AIR.

All soils contain air. Even some soft rocks do. Only the densest forms do not contain it. This air has CO^2 which forms a greater part of it. Ground air is partly composed of gases arising from decomposition and putrefaction processes going on in the soil. The percentage of CO^2 is greater in ground air than the atmosphere. The proportion of O is diminished, but that of N is about the same. There are also ammonia, hydrogen, ammonium sulphide and marsh gas. Boussingault and Levy's analysis of ground air taken at $1\frac{1}{2}$ ft. from the surface gave O.-10.35% by vol., CO^2-9.74% N.79.91. CO^2 increases with the depth from which ground-air is drawn. Rainfall seems to affect the proportion of CO^2 in ground-air. It was

observed that in a field near Calcutta, CO^2 in the ground-air in the soil increased with the rainfall and decreased with dry weather. Up to the temperature of 60°C. the amount of CO^2 produced by abundance of organic substances increases. At 100 °C. and higher it almost ceases to increase. In Dr. Copeman's words, "the amount of moisture most favourable to the production of CO^2 is reached when water is present to the extent of about 4%, although the surface may be entirely covered with water." In spring the upper layers of soil are very liable to get warmed suddenly, and so more CO^2 is found for short periods in the superficial layers than in the deeper layers. As summer advances the proportion of CO^2 increases with it, reaching the maximum at the height of summer, and decreasing as summer wanes. Pettenkofer and Foder suggested that the winds sucked out the ground-air and so the proportion of CO^2 in soil was reduced. Copeman says " Occasionally sulphuretted hydrogen is found in ground air, particularly if the soil be moist; it appears to be derived from the sulphates present in the hard water with which the soil is charged. Marsh gas or carburetted hydrogen also may occur as a result of the decomposition of certain organic substances; it may be obtained from putrid mud, and as in the case of carbonic acid and ammonia, is found in greater amounts in the deeper layers. This factor may even be more important than the pollution of soil." It is the small or large amount of air that reaches the organisms that varies the kind of decomposition that takes place in any soil. In the process of putrefaction even organic substances are broken up. Pastem and Cohn found that

nitratis became converted into nitrites and even with NH^3. When Schplösing drew air containing different amounts of O through earth having putrefactive organisms, he found in every case that CO^2 was forced, while the amount of nitric acid in the soil was reduced. When a hot day is followed by a cool one the ground-air escapes into the atmosphere. On a warm day it remains stagnant in the soil. In houses built on made soil and heated artificially, soil-air is drawn up from considerable depths unless the site be covered with asphalte or concrete. Similarly air from leaking cess-pools and drains may contaminate the soil. Ground-air is set in motion by winds blowing against surface soil and by the change in the level of ground water. Heavy rain causes a compression in the ground-air. In cellars there may be areas of low pressure, and therefore the ground-air rushes in and then goes up into the house. In winter the ground becomes frozen, and thus rather impervious. The unfrozen warm parts of a building permit the ground-air under pressure to permeate. This is enough to show the relation between ground-air and health.

SOIL AND BACTERIA.

While speaking of the gases of ground-air coming from putrefaction, reference was made to micro-organisms. Though putrefaction happens in the superficial layers, yet it is especially marked in the deeper layers where there is but little oxygen and where anearobic bacteria are known to thrive. Dr. Sidney Martin, after experimenting on virgin soil and organically polluted soil with typhoid bacillus, found that virgin soils are unfavourable to typhoid culture,

but the contaminated soils in the neighbourhood were very favourable. The results varied to an extent with temperature and moisture, but also showed that the growth and diffusion took place at ordinary temperatures of the atmosphere. He showed that garden soils when sterilised were more favourable to the vitality and growth of the typhoid bacillus than when unsterilised. Typhoid germs are very tenacious of life and under certain conditions can survive from one summer to another, in spite of rain and snow, frost and heat. It is easy to see that micro-organisms are much more numerous in the upper layers than in the lower ones, except that anearobic bacteria prosper well at greater depths. In moist ground numerous forms of micrococci are met with. These bacteria cause putrefaction, oxidation and intrification, which was believed by Schplösing and Muntz to be a fermentation change.

The organisms capable of inducing diseases that are occasionally found are (1) bacillus of titanus, (2) of anthrax, (3) of oedeina, (4) of typhoid fever, and (5) of malaria, but this is not generally agreed to have pathogenic influence. It might be stated that there are other disease germs which can live in soil but are not either found or isolated. Fräukel has shown that cholera bacilli can grow and multiply in soil at various depths (though up to now they have not been found in soil). According to Ballard, diarrhœa needs a definite micro-organism for its appearance. This microbe "has its normal habitat in the soil," although not as yet isolated. Opinions differ very much as to the pathogenic powers of these organisms found in the soils. Some are firmly convinced that they are a great source

of danger, and others take a very optimistic view. Dr. Copeman, who has made a special study of the effects of soil on health, takes a mean course and says, "There can be no doubt that pathogenic organisms do exist in the soil, but their power for harm would seem to be practically very small indeed. The organisms which flourish in the human body languish and cease to multiply in the soil, where the conditions are unsuitable for their multiplication or even for their survival. They get overgrown by saprophytic microbes, and even if the do not die, the risk of their finding their way into the ground water is practically nil, for humus is the best of filters." Yet it is already stated that cholera bacilli can flourish in soil, and also can some others. It is safest, therefore to look upon them as a possible source of danger, and thus take all advisable precautions to err on the safe side until the question can be definitely decided.

SOIL AND TEMPERATURE.

While speaking about the colour of and vegetation on soils, reference was made to temperature of soils. Delbruck first described the effect of soil temperature on disease, in connection with a cholera epidemic associated with a maximum of soil temperature and a certain degree of soil moisture. It influences the spread of malaria and is related to summer diarrhœa. The correspondence that is found between the temperatures of air and soil is only at the superficial layers of soil. Foder found that "the greatest range of temperature was noted in the superficial layers; at half a metre below the surface there was a variation of even

20 °C. below the monthly means of one and the same year, but at a depth of four metres, there was a variation of $5\frac{1}{2}$ °C. only, and in some places hardly more than 3 °C." Sand gets warm much more quickly than clay. The soils containing more water than others are colder because the temperature of water increases very slowly, or, in other words, the damper the soil the longer time it takes to become warm. Sandy soils are dry and warm and clay soils are otherwise, as they retain moisture. Another reason for this is that clay soils, besides being slow to warm, lose their heat very quickly, but sandy soils retain the warmth for a fairly long time. This power of retaining heat in a soil is due partly to the physical and partly to the chemical properties. It is well known that radiation as a rule occurs at a quicker rate than absorption. This is equally marked on soils where there is plentiful vegetation. Thus such soils cool more quickly than they heat.

SOIL AND DISEASES.

These soil water and moisture, soil temperature, ground-air and soil bacteria lead to certain maladies. Though the relations between different kinds of soils and different kinds of diseases are shown, it has never proved that any disease is due wholly and solely to any particular kind of soil, but it is often observed that certain kinds of diseases are more or less helped forward by certain kinds of soils. To take the most striking case of malaria, it is well known that soil has a great relation to its prevalence, but at the same time this is the most puzzling case, as will be seen from the following remarks. Malarious soils are mostly marshy,

and in addition to being saturated with moisture such soiis contain large proportions of carbon dioxide, sulphurated hydrogen, marsh gas and watery vapour. They may also hold in suspension debris of organic substances of vegetable and animal origin, diatoms, infusoriæ, algoe and various micro-organisms. This shows that damp ground, especially if not cultivated, is an important instrument in causing malaria, and particularly so if it happens to have a high soil temperature, say, about 60 °F., and vegetable impurities in soil and ground-air. Dr. Copeman says, " There is, however, a general consensus of opinion that malaria most abounds in jungle, swamps, and virgin forests, the disease showing an evident relation to low land, abundant water and hot moist climates." Now, examining the other side, one finds that some districts in Italy where malaria prevails are in considerable parts sterile and altogether wanting in water. Again one finds that malaria cannot be regarded as by any means prevalent in Ireland, though the country is much covered by peat-bogs. In some districts that look quite dry and arid is known to exist ague of a most virulent type. This may show that it is not absolutely necessary that there should be an abundance of decomposing vegetable substances. To be on the safe side, it is best to avoid marshy ground as generalised by Dr. Copeman.

If some ground in the neighbourhood of a soil suspected to be malarious is to be utilised, it is very advisable to isolate the malarious piece of ground by a belt of trees or sheet of water, because in this way malaria poison can be localised. It is also desir-

able that firm banks should be built round marshy grounds and no weeds be allowed to grow round the border. They should be drained and ponds made into them. The anophelis mosquitoes are known to transmit malaria. Small fish should be put into these ponds and kerosene may be sprinkled on other parts. In this way mosquitoes can be combatted with. Pettenkofer, Fodor, Baldwin, Latham and other sanitarians impressed emphatically the fact that there is some relation between the spread of cholera and enteric fever and the variation of the level of ground water. Thus typhoid has a specially strong connection with subsoil water, if it is comparatively near the surface and if its horizontal movement is slow. It is a good plan to avoid these grounds which have subsoil water nearer than 6ft. Yet, if so many different kinds of soil be avoided for different reasons, there will be very little ground left for use in the neighbourhood of certain towns. So when indifferent soil is to be utilised, a good concrete and asphalte foundation will remedy the defect, provided the precautions are thorough, wells and waterways are well guarded, and the drainage system is efficient. If the surface is damp the soil will be cold and the air misty. This may promote diseases like paroxysmal fevers, rheumatism, nueralgia, and several maladies of the lungs. Dr. Bashmore says, "Undue dampness is a potent factor in the causation of rheumatism." It is supposed that there is some connection between soil-dampness and phthisis. This may be so by the dampness rendering people susceptible to the attacks of the specific germ of phthisis. Cold wet soils and damp marshy places have the greatest share

of diphtheria prevalence. Dr. Thinsfield showed that subsoil water may be so close that the dampness of certain houses may be entirely due to it and the cellars always contain it. This dampness is acknowledged to be a factor in the development of diphtheria. "Bruhl and John claim to have proved that an increase of mortality from diphtheria is closely connected with prevalent atmospheric conditions, the maximum mortality being in those places where there is throughout the year less equality of temperature and humidity of the air." According to Pattenkofer and others, the movement of soil water is the main factor in the spread of cholera because of the fact that "cholera never prevails epidemically where the soil is impermeable to water, or where the level of the ground water begins to descend after having reached a higher level. Lewis and Cunningham found that in Calcutta when cholera was at a maximum the water level was at a minimum, and *vice versâ*. There are various and varied variations regarding different minor ailments and soils and their conditions, but as they are not generally accepted they can hardly be added here. The relation of malaria, typhoid, diphtheria and rheumatism to soil is proved beyond doubt, yet it cannot too strongly be impressed that soils are not the sole causes of these diseases, but more or less important factors working with others in causing and diffusing them.

OVER-CROWDING AND TOWN-PLANNING PROBLEMS.

Now after dealing with the soils and their effects upon people abiding on them, the question of town-

planning should be considered. Town-planning has three distinct features. One is an attempt to meet with the difficulties of over-crowding and modern sanitation. The other is the creation of independent garden cities to prevent the depopulation of country districts affecting agriculture. The third is the establishment of garden villages round some one particular industrial organization.

The increase of population is the natural consequence of the prosperity of a locality. As a general rule population increases at a much quicker rate than the relative increase of accommodation. This is one cause of over-crowding. The other is that the modern demands for improved sanitation render old dwellings more or less uninhabitable. Both of them in some way or other cause increased subletting of houses which were not originally constructed for subletting. This subletting of unsuitable dwellings brings more dwellings into question from the point of view of modern legislation demanding a minimum standard of hygiene and comfort. Dr. Sykes says about the population driven into sublet houses "that over-crowding exercises its most deteriorating and permanent influence upon the health and morals of thousands of children, youths and young persons whilst waiting for the erection of new buildings at a distance that will not affect their neighbourhood except by a back-wash years hence." Thus the problem of town-planning becomes extremely complex, because besides the fully-expected difficulties of providing sanitation against unfavourable conditions of nature and of the difficulties of neglect of sanitation for ages, it has to solve economic and even

psychological difficulties. In some of the early and even modern attempts, psychology was neglected, with the result that the attempts failed or turned out to be unsatisfactory. This is why the schemes of Napoleon III. while the President of the French Republic, of a "cite ouvriere" and of Mons. Jean Dolfus os "La Société des Cites Ouvrieres" failed. They did not consider the fact that the people would not like to be barracked. As a rule a good thing is secured by paying good money, but the town-planner, in respect of the housing of the poor, has to contrive to give good material for bad money. And worse than that is that even that bad money is difficult to get. Thus in spite of the desire of people to do something for the housing of the poor it cannot be done sufficiently quickly to put matters right, and over-crowding goes on. One of the extreme cases of this is in Manhattan Island where, according to Dr. Bashmore, in one section of the East Side, nearly 2,000 persons dwell on a single acre—the blackest, thickest mass of humanity in the whole world. In some English towns one person in every ten is living under conditions of over-crowding. Mr. Rowntree says, "In about half the towns of England there are many working men who cannot get accommodation suited to their needs." Thus in town-planning there are five distinct things to be considered :—

(1) The provision of sanitation to the old buildings of the town.
(2) The prevention of over-crowding.
(3) The populating of suburbs.
(4) The housing of the poor.

(5) Establishment of transit facilities, improvement of streets, and organisation of public institutes.

At first sight the 3rd and the 4th may appear to be only the solutions of No. 2. The fifth may appear to be more a matter of public health and public welfare, yet they are all interdependent and over-lapping, and at the same time distinct. The housing of the poor does not by any means prevent over-crowding, because in many modern towns accommodation in municipal or other lodging-houses or large tenement buildings is provided for the poor working classes. The lower middle class, composed of clerks, underpaid teachers and others, are not willing to live in such more or less charitable buildings or institutions, and thus they suffer more from over-crowding. Suburb population prevents over-crowding of both the upper and lower middle classes who wish to live in private dwellings. Up to now, as a general rule, workers in factories do not much care to go to suburbs at a distance. Dr. Sykes remarks, "It is difficult to understand why there should be any insistence upon building at a distance classes of dwellings that the over-crowded persons for whom they are intended will certainly not occupy when they are completed."

Then again, neither the population of suburbs nor the housing of the poor will solve altogether the over-crowding of the middle zone of the town. It is proved from census returns that immigrants settle mainly in the more outlying parts. These parts are generally the middle zone lying between the town and its distant suburbs. Thus the question arises whether the provision of buildings in the distant

suburbs or of buildings for the poor in the town will stop the over-crowding of the lower-middle zone : first, because some people do not mind being over-crowded; secondly, because they do not wish to live very far away in the suburbs as it may be too far from their business places, or they may not have families or inclination to live in families; thirdly, because they cannot live in buildings erected for the housing of the poor. This much should be enough to show that these five features, though interdependent and over-lapping, at certain places, are to be treated separately for preference. To provide sanitation for the old buildings of a town, first of all it should be ascertained whether the buildings are in conformity with the demands of sanitary law on points of the minimums of light, air and sanitary and domestic conveniences. In whichever requirement they are wanting they should be improved. If they cannot be improved altogether to suffice the wants of a dwelling, they should be turned into healthy places of business. It is apparent that for places of business where people do not remain so long as in their dwelling, it is not necessary to make equally stringent demands in regard to sanitation and comfort. If they cannot be turned into healthy business places, they may be used as storehouses and go-downs, because of economy of finance at hand should be considered so that money otherwise spent in demolition and reconstruction may be used in other ways. If they are in a dilapidated condition, if their very existence is a nuisance, and if their removal does good to the better buildings in the neighbourhood, then they should be demolished. Demolishing buildings without constructing new ones

to replace the old ones inevitably leads to over-crowding, and so there should not be an undue desire for demolition. Yet it should be borne in mind that the harm done to our generation due to the over-crowding caused by demolition is less than the continuous harm that very insanitary buildings may keep on exerting to generations. As to the prevention of overcrowding, it is already shown that neither the erection of private dwellings in distant suburbs nor of huge buildings for the working classes altogether solves the difficulty with the middle zone districts directly or rapidly, and in some cases not at all. It is purely a question of legislation. Law should limit both the number of people using a bedroom according to its dimensions, and also the number of houses in an acre. The London County Council pursues a rule for houses managed by it that "the standard of two persons a room must not be exceeded by more than one child under three years." This is not only from the sanitary but from the moral point of view, as is apparent when referring to a bedroom. Thus over-crowding is to be prevented by law, and in order to enforce such law it is necessary to provide adequate dwellings.

DWELLINGS.

Dwelling-houses may be divided into different classes. (1) The private dwelling-house, which is a house used exclusively by one family. Most of these houses are used by a more or less refined class of people who generally take care of themselves and do not crowd very much. All the attention that they need is the maintenance of ordinary sanitary conditions of

construction and the necessary upkeep. (2) The common dwelling-house, which may be occupied by more than one family. These houses are liable to suffer more or less from over-crowding, as they are used by a different class of people. They are divisible into (*a*) those used entirely in common so that they become common shelters and common lodging-houses, having separate cubicles in corridors, or (*b*) those used all in common except the sleeping places. They may have separate bedrooms.

Those of (2) (*a*) are almost sure to get over-crowded, if they are run by private enterprise, unless constantly examined by inspectors. If they are managed by municipalities or some sanitary body they are sure not to be over-crowded, and are the only kind of dwelling-houses about which there can be certainty in this direction. Those in class (2) (*b*) are the boarding houses, hotels and residential clubs; these if let alone by the inspector are sure to be over-crowded. (3) The third class is formed of those that are let without service and without food, and approached by a common staircase, the dwellings differing in privacy according to the degree of structural severance and of combined usage of the domestic and sanitary conveniences. These are divisible into: (*a*) those containing separate and self-contained flats; (*b*) those that are self-complete dwellings in which part or all of the sanitary conveniences are situated outside and not used in common but on the same floor; (*c*) those that have separate rooms but have the associated use of domestic and sanitary conveniences by families on the same floor. These are not desirable in case of

infectious diseases and also from the point of view of privacy; (*d*) those that have no constructional separateness, but only agreed occupational severances, where domestic and sanitary conveniences are used in common. These are quite undesirable in cases of infectious diseases and also from the point of view of privacy and moral well-being. There are likely to be constant quarrels and constant neglect of cleaning those parts that are used in common, because everybody's business is nobody's business. This is the misuse of a private dwelling turned into a common dwelling. It is often done by two or three lower middle class families who begin this kind of dwelling as friends and end it as enemies. All these domiciles of the third class are more or less undesirable, excepting perhaps (3) (*a*) flats, which, if managed well, are quite satisfactory from the sanitary point of view. Yet all of these are likely to get over-crowded. This is the general classification of all dwellings, but the habitations of the poor in London can bear a separate classification into three divisions. (1) The lowest division has houses congested in slums, deficient in light, space, ventilation, warmth, dryness and water supply. These are occupied by about two to three millions. (2) The second division houses have a living-room, a scullery, and two or three bedrooms. These usually open directly upon the street. About 65-80% of working people stay in these. (3) This is the highest division of working class houses, built 20-25 or fewer to an acre, with a parlour, a hall, a scullery, three bedrooms and sometimes a bathroom.

It is apparent that the first division is altogether unfit to live in, and yet it exists in spite of sanitary law, but only because there are no places where the people could be accommodated at the same rent. These houses supply the towns with a greater number of criminals in proportion than any other. The ancient evils of neglect of town-planning cannot be remedied all at once, though the eyes of the humanitarians have been opened to the fact that some attention must be paid to the housing of the poor. The second division is not much to be condemned but for the carelessness and ignorance of the inhabitants. With some care and natural or created inclination towards refinement, most of these habitations can be tolerably comfortable, and hygienic. Mr. Pigou very correctly says, "A great part of the squalor and discomfort of certain houses of the poor is not the result of inability to pay a reasonable rent, but flows rather from the low character and the want of training of those that inhabit them." This is not the only psychological factor creating misery and discomfort in the dwellings. The influence of the landlord and landlady is quite appreciable. If the landlady in some way or other encourages her tenants to be very cleanly, she will relieve a great deal of misery to the tenants and much expense of renewal to herself. If a landlady who lives on the premises herself, keeps her parts of the dwelling exemplarily clean, she will create a moral obligation on her sublet tenant to be also clean and this will not fail in many cases. On the contrary, the landladies of such poorer dwellings often have an entirely bad influence, being degraded women themselves. In London

there are tenement dwellings of four or five and more storeys in which can be found women so incapable or old or unwilling that they have not come down to the ground floor for four or five years. Mr. Rowntree says, "It is disastrous to the nation as a whole that many of its workers should be unable to pay for proper accommodation, nor can it ultimately benefit the employer."

HOUSING DESIDERATA.

There are many laws, bye-laws and regulations giving the different minimums to be allowed for light, air, space, sanitation, heat and dryness necessary to enumerate constructional details of sanitary houses. Yet to give a rough idea just a few important points from practice may be stated. The minimums of a comfortable dwelling would require (1) a living-room, (2) one bedroom for parents, (3) two bedrooms for children, (4) a scullery, (5) sanitary convenience, (6) a bathroom (though not found in very many good or bad class dwellings at present). The floors and walls should be perfectly dry. When such dwellings are in the basement, special attention is needed to sanitary requirements and especially to dryness. A very good dry concrete foundation and damp-proof courses are of utmost importance. The height of the rooms of basement and ground floor should be about nine feet, and of higher stories about eight feet. The roofs must be efficient in keeping off rain and cause no undue dampness. The living room should be the most commodious and not less than 150 sq. ft. in floor area. The scullery should not be less than 10 ft. × 7ft. and should have a pantry intercommunicating if possible,

but must have means of independent ventilation from the extenal air.

When such dwellings form part of large housing-buildings the sanitary conveniences will, of course, be detached from the dwellings, and daily taken over to the closets by the women of the dwellings. If the closets are kept too far the women do not like to take the excreta over that distance during the day, and so store them up in a corner of the house, and thus vitiate the air of the dwelling. This has led to some epidemics. The staircases should not serve as air-shafts, so that polluted air from one dwelling or of the living-room can enter into another dwelling or bedroom. This necessitates very careful architectural designing. Messrs. Smith and Young, discussing such buildings, say, "The corridors have been dispensed with, and each dwelling is now usually independent of the others, so far as enclosed atmosphere common to all is concerned; for the staircases are generally arranged to give access to one vertical series of dwellings only on each side of them, and are entirely open to the external air."

Unless all the rooms can be ventilated or lighted from a street alley adjoining a street, there should be an open space at the side or back of them, according to the size of the frontage. If frontage does not exceed 15 ft. in length, an open area of 150 sq. ft. should be provided; for 20 ft. length, 200 sq. ft. area; 30 ft., frontage, 300 sq. ft. area; and for more than 30 ft. frontage, at the least 450 sq. ft. area. Messrs. Smith and Young assert that "a system of detached blocks of four houses, mostly two storeys high, besides

cellar and attic" has proved successful. The idea in housing is to provide tolerable dwellings as cheaply as possible. On account of the high value of land in towns, very large housing buildings have to be made. When their size becomes too large the economy is affected. The walls have to be thick and a large number of fireproof staircases have to be provided. Such other considerations make the buildings expensive and accordingly the rents become so high that the dwellings with one or two rooms are all that the majority of workers can afford. Back-to-back house construction is condemnable on hygienic considerations. These remarks take us to other houses than large dwelling-houses.

Limitations as to the height of houses should be set in all cases, varying according to the width of the streets. Some cities have made a regulation that the height of houses should be one and a half times the width of the street. Dr. Bashmore suggests, "On a corner plot something like twenty-five per cent. should be reserved for air space, and on an inside plot probably forty per cent. should be left unoccupied." It is easy to see that houses in east and west streets will require wider front and back spaces than those in north and south streets. The practical limit adopted is that the height should not be more than the sum of the width of the open spaces at the front and at the back. Only half the open space at the back is considered to belong to one house, so the house can have the height equal to twice the width of its own rear space, and an angle of 45° is to be applied at the front and of $63\frac{1}{2}$° at the rear. It is necessary to impress

the fact that the open spaces should be attended to and not abused as refuse receptacles. Dr. Sykes says, "With regard to the open spaces immediately contiguous to dwelling-houses, the soil in towns always becomes polluted and prejudicial to health. There are two ways in which it can be effectually dealt with, the one is by cultivation as a garden, the other by an impervious paving, so levelled and drained as to be readily cleansed. As a temporary expedient the surface may be gravelled and rolled, but this is not of permanent benefit."

STREETS.

The construction of streets, roads, etc., falls within the domain of civil engineering. Yet several features of streets also come into the realm of sanitation and town-planning, because, as Dr. Bashmore says, "Streets dirty and filthy with dust, wafted hither and thither with every wind, cause various eye, throat and bronchial diseases; and streets wet and slushy with snow and ice cause wet feet and the consequent colds and pneumatic troubles." In towns, town-planning causes the laying out of new streets in districts both to facilitate communication between districts and to improve bad quarters. To construct real streets a great deal of demolition of houses becomes necessary, which, while solving one evil, increases the congestion evil unless precautions are taken to provide housing facilities, and to prevent over-crowding, by legislation. In Australia, wholesale demolition led to the overcrowding at Darlington in Sydney. The consequence was that the death-rate in

that town increased, in Darlington the death-rate being 15.65, whereas in the other parts of the city it was 11.26. Its infant mortality is 229 per 1,000, whereas for the city it is only 82 per 1,000. Yet the good result of such steps in town-planning is exemplified by the creation of the Wentworth Avenue in the New South Wales Capital, which is now a street 100 ft. wide and " runs through an area of some eight acres which was originally a congerie of disreputable houses, Chinese opium dens, slums, etc. Another striking example is the new Princess Street in Bombay. In fixing the line of a street in a town, improved inter-communication and the relieving of building congestion are to be aimed at. There is not much freedom left for considering its orientation, but in country-planning this can be considered much more fully. The square orientation gives the greatest amount of sunshine and makes it more equable if buildings are constructed in parallel lines with open spaces in between, and where no houses in the streets are at right angles. When dwellings are constructed on all the four sides of rectangles then the fullest sunshine can be obtained by diagonal orientation, though the rear will have less perflation if the central space is completely enclosed. This is what happens in the ordinary forms of construction of street blocks. The suggestion of Clement and Trelat for getting sunshine on dwellings on a road oriented east and west are impracticable. Dr. Sykes says, " It must also be remembered that a north light without sunshine is preferable for many industrial and artistic occupations." As to the orientation of rooms, the eastward aspect is best for morning and dining room.

The sunshine during the afternoon and at sunset can be best obtained in a sitting room with a south-western aspect. Study-rooms also need good light in the afternoon, and so a westward aspect is considered most suitable for them. Kitchen, larder, etc., can well have the north-western aspect. Dr. Sykes says, "Arnould has concluded that the orientation of streets is beyond exact control, and attention should rather be directed to limiting the height of houses in relation to the width of streets." Those who have planned garden suburbs and garden cities have found that the laying out of roads is most difficult, as one cannot see beforehand where the traffic will be most intense, etc. Yet in the cases of garden cities, if the different kinds of localities are fixed, the traffic can be more or less approximated. Roads should be planned so as to save good trees. Purchasers of certain parts of land should be prevented from building anything but summer-houses, and from felling trees In Ruislip-Northwood Town Planning, Alderman W. Thompson says, "Roads of some half a dozen different types are being provided, varying in width from twenty to sixty feet, according to the amount of users that may be expected, and arrangements are being made to allow a lighter construction in the case of purely residential districts in exchange for the giving up of certain areas of land for open spaces, either public or private." It is indeed the most rational method to consider every street individually and not put any very strict limitations on municipal or town-planning authorities. In the town extension of Frankfort, the Town Council was at perfect liberty to make the widths of roads according

to the requirements of different districts. This has led to the rational result that streets vary from 20 to 200 feet. In Frankfort itself the carriage ways as a rule are so wide that four carriages of average margin of 8 ft. 2 in. can be driven side by side. There is one conclusion at which all good town-planners have arrived regarding the width, that it is not at all desirable to have residential streets very wide, and that very many of them are too large. This is the wrong kind of town-planning which is often seen in Germany. In Mr. Horsfall's words, "It was not sufficiently realised by the public that in many cases greater economies could be effected in road-making than by reducing the price of land." The roads can be made cheaper by making them narrower, but the open space can be compensated by having less houses on the sides and allowing space for gardening. Mr. Henry Vivian complains, "On building estates round London, macadamised roads of a width of from forty to fifty-five feet are often insisted on, where a width of from fifteen to twenty feet would be ample with a reasonable limitation of the number of houses to the acre. On the other hand, the traffic on the main road leading to such estates is throttled by their being too narrow."

It is also to be seen that there is some such cohesion in the new system on which some new suburb is to be planned so that the new district forms, as it were, an integral part of the city of which it is called the suburb. Another interesting point is the suggestion of Mr. Shawcross that "loop roads can be made so that through traffic can skirt the town instead of going through the centre, thus saving roads the wear and

tear and also increasing the amenity of the town." There are eight considerations to be taken into account in making streets :—

(1) The orientation, (2) the advisability of adopting as far as possible the direction of cattle-paths in hilly districts, (3) the preservation of trees and sites of great natural beauty, (4) the amount and description of the existing or probable tradc, (5) the gradient width and continuity of the streets, (6) the class of property which abuts on the streets, (7) the local facilities for obtaining a suitable material for pavements, (8) the financial position of the local authority who are responsible for the paving. In addition to these considerations the ideal road has thirteen requirements. (1) Impermeability, (2) durability, (3) foot-hold, (4) ease of traction, (5) adaptability to all gradients, (6) adaptability to all classes of traffic, (7) noiselessness, (8) non-manufacture of mud or dust, (9) ease of cleansing, (10) ease of repairs, (11) economical in first cost and maintenance, (12) not influenced by climatic changes, (13) good appearance.

This should be sufficient to show that the laying out and construction of roads is no easy matter, and will also demonstrate what a good guide that splendid and ingenious table of Mr. A. Percy Boulnois can be. Mr. Boulnois says, "The best and most durable pavement, other considerations being equal, is the most economical in the end." The selection of paving material or roads depends on (1) the gradient, (2) the width of the street, and (3) the nature of abutting houses. Dr. Henry I. Lunn, speaking about the roads of Frankfort, says, "Of late years only a so-called

first-class pavement is laid in all main thoroughfares, which are paved with stone setts, and this consists of a hard-rammed foundation upon which—to the exclusion of all other materials—granite setts are laid. This pavement is much better than the old basalt pavement, stands the traffic well, and fulfils all the conditions required of a good sett pavement. For the grouting of the joints asphalt is now used instead of cement, which, if good material is selected, does not easily crack or break, and also affords a firmer foothold to the houses.'' For these roads for which a kind of water-tight construction is needed and where the noise has to be as little as possible, a pavement of Kieserling's cement-macadam has proved very satisfactory. Slabs and small cubes of cement are used for paving the permanent causeways, together with granite kerbstones. Such are economical and dry quickly after rain, besides being pleasant to walk upon and giving a good foothold. Mr. Boulnois' opinion is that '' stone setts may be very suitable for streets of warehouses, but would be inexpedient for residential streets, especially where there might be hospitals, schools or places of worship. Asphalt would naturally be unsuitable for streets of steeper gradient than 1 in 60, wood 1 in 36, and stone setts 1 in 16.''

In Germany, from recent experience, wood is used only for streets of greater slope than 1 in 60 and for tramways and bridges. Those who are in favour of wood paved roads claim that (1) they are almost noiseless; (2) they create no mud or dust in themselves; (3) they offer but little resistance to traction; (4) they give a good foothold; (5) they are fairly durable; (6)

they are moderate in cost; (7) they are comparatively easily repaired; (8) they can be used on gradients up to 1 in 27; (9) they suit all classes of light traffic; (10) they have a good appearance, (11) they are fairly easily cleaned. In certain cases wood paving is the best, provided plenty of water is available to keep it clean. Major Isaac, Mr. Boulnois and others consider that wood pavement is insanitary. Germans found wood pavements unsatisfactory, and replaced them by asphalt. Good pavement has the effect of improving the value of houses abutting on the street, and cases are known of rents having increased 20% to 30% on that account.

It is desirable to use the same paving material throughout a street because the drivers and horses become used to it and work more confidently. It is essential that nicely constructed roads, etc., should be kept in good and clean condition in order to get the fullest benefit. Provision should be made for the cleansing and watering of all asphalted, macadamised and paved streets and squares, for the removal of ice, snow, street sweepings and refuse. In Frankfort the streets having much traffic are swept six times, and others three times, per week, the important main roads four to six times, and others watered twice daily. Some rich municipalities of Indian towns sprinkle petroleum to abate the dust and mosquito nuisances. There are some automatic street cleaning machines, but these are not yet universally adouted. A patent of Messrs. J. & P. Hill, of Sheffield, gave very satisfactory results in the munncipal trails. The usual way of cleansing streets is to sweep them and to pick up the

droppings with a tray and a brush by simple manual labour. Mr. Boulnois says he found that the expense of cleansing setts by hand in the ordinary way by the hammer, etc., was tedious and costly, as on one occasion, which was carefully noted, it took seventeen men ten and a half days to clean 677 superficial yards of ;4in. cube setts, which was equal to 10½d. per square yard. He consequently tried, with every success, the process of boiling the old setts in a pitch-boiler, the method and cost being as follows :—Creosote oil is heated in an ordinary road pitch-boiler to about 266° Fahr., and the setts are thrown in and allowed to remain ten or twelve minutes, when they emerge thoroughly clean and fit for use, at a cost of 4.07d. per superficial yard; the labour of two men with this method being sufficient, as against seventeen men in the former case working for the same time." Though this has nothing to do with the ordinary street cleaning, yet this research of Mr. Bulnois is well worth noting by town-planners, as they may have to get old setts cleaned for repairs of roads.

ECONOMICS OF TOWN-PLANNING.

There will be innumerable deductions to be arrived at by the analysis and synthesis of various economic elements in town-planning. To do so is to go beyond the dimensions and need of this book. The most important features are: (1) supplying the demand for housing on very difficult financial terms, (2) acquiring the needed capital, and (3) balancing the claims of landlords and tenants. Sometimes a plan that may be good for settling one of these difficulties is not suitable

for others. That there is a great demand for houses shows that in this case there is a shortage of supply. The shortage of supply is attributable to various causes. The demand is mostly from the working classes and the lower middle classes. The working people are so poor that they cannot pay rents which will interest the builder. The builder finds it more profitable to construct better class houses where he stands a good chance of getting a high interest on his capital even if he has to float a larger capital. Thus, there are very many good class dwellings remaining unoccupied while the poorer class dwellings get over-crowded. Again, the demands of sanitation legally making certain dwellings unfit, increase this shortage. Then again, the improvements in sanitation make it possible for the people of weaker constitution to live and also increase the efficient birth rate and decrease infant mortality. Thus the units of habitants increase and the units of habitats decrease.

According to Malthusian suggestion, misery and crime should be allowed to kill the superfluent. But it is more human to supply shelter instead of depending upon death as a solution. The workmen cannot pay enough to make housing of the poor tempting to landlords, because their wages are low. This makes one think that increasing wages should solve the difficulty. Yet that cannot do all, because the increase of daily wage does not necessarily augment the total income. It is the total amount of work to be obtained at the increased wage that matters. This means that the industries should be encouraged so that more work at good wages may be

found. If in a town a new industrial place like a factory is started, then it draws labour, and thus is caused congestion of the working class dwellings in that district. Again, if any industry is to be started, capital is needed. Now, at any time there will be capitalists having a certain amount of investable capital; if industry is encouraged, some of this money will be invested in it. That means that the available capital for investing in housing will be still less, and thus less dwellings will be constructed to meet the increased demand of a newly-started industry. All these difficulties can be solved by garden villages and garden cities. The working people drawn by an industry can live near it as in garden villages like Port Sunlight. The people who first started garden cities did so with a view to preventing what they called the depopulation of the country. While doing so they also helped in getting people work in agricultural lines. Thus this method solves the difficulties of increased wages and increased work without the bad effect of over-crowding by town industries. A conclusion of other economists, yet it is quite logical from the facts stated above. The other solution that may be suggested is that every manufacturer in the town must by law undertake to house not all but a certain number of his employees. At present the housing of the working man is left to the town-planners, whose greatest difficulty is to get the necessary capital. The Finance Act produced a scare which affects the town-planner very much. It becomes difficult to get finance for this purpose on an ordinarily advantageous or reasonable basis on account of the fact that an investment in house property is always an anxiety, while on

the other hand there are absolutely liquid securities as alternatives. If the workmen employed in house construction are given higher wages; if the houses are to be built with higher standards of comfort and sanitation; and if the price of land goes up, then it is only natural that the cost of house construction must increase. During the last few decades it has gone up 10 to 12 per cent.

This is another hindrance to producing a satisfactory supply. The cost of house construction depends on (1) the price of the land, (2) the cost of developing it, (3) the cost of construction, (4) the interest payable on the capital, and (5) the rates to be paid. Now (1), (2), (3), and (5) are likely to increase, and in most cases have increased. As to the 4th, this must be lowered as much as possible so that the poor people can afford to live in these newly-built houses. In towns the price of land is so high that the neighbouring country district must be explored. Even if the working classes do not go there, some people may do so, and thus more room may be made in the town for the working men. Yet this does not happen in the same proportion as the overcrowding, and so some houses have to be built in the towns. This leads to enormous, tall housing buildings. If their dimensions are not kept within certain limits the economies effected in land are used up in special constructional requirements. This is why people who would greatly like to build nice-looking houses, instead of barracks, find it economically impossible. In short, and in rather uncouth terms, good value is to be given for bad money. This is nothing very extraordinary or insurmountable,

because one knows that good value is given for no money at all in charitable hospitals and other places. The question therefore depends largely on the charity of the people with money. On this score the monied people are to be thanked because up to now most of the housing of the poor has been facilitated by them, however guilty they may be, in the eyes of some people, for *having made the money*. Yet at the same time it is to be remembered that a very large proportion of income is paid by the working classes in their rents. Mr. Rowntree asserts that in England "as a whole probably the majority of the working classes are paying at least one-sixth of their total income in rent, although the quality of the dwellings is often so unsatisfactory."

These difficulties show that the State must come to the assistance of the working classes by giving them subsidies according to the quality of dwellings they are required to inhabit. Some people see in this suggestion all the drawbacks of the subsidies of the Poor Law because of the want of careful thought. On this point Mr. Pigou reflects as follows: "Subsidies, the amount of which, as paid to separate individuals, varies not inversely with their earnings but directly with the quantity of their purchases of some commodity, are wholely different from the subsidies of the old Poor Law." When establishing any kind of bounty, it is necessary to take precautions that it does not differentiate in favour of any congestion, as that would do more harm than good. This is helped forward by the experience of the New Zealand Government which erected detached dwellings for working men in the principal centres. These dwellings could be purchased by deposit of £10

and a weekly payment of 15s. to 17s. 6d. for 25 years. So the houses came within reach of only the better paid and more skilled artisans. It is not possible to make drastic changes in economic exploitation either through municipalities or capitalists. There are certain ways of cheapening land. If there is improved transit from a place where the land is dear to a place where the land is cheap, it brings land within the reach of people. Again, it should be made possible to obtain land cheaply by compulsion, as is done in Italy, where it is possible for the municipalities to buy land compulsorily for the purpose of erecting dwellings for workmen and other housing requirements. The other method is to have improved rating reforms. The rates to be paid on the houses also interfere, and so a portion of the rates should be put on the land instead of the house. Mr. Rowntree says: "A site, for instance, that is worth a thousand pounds an acre, and is let at a pound an acre for grazing, is rated on a basis of a pound an acre. Clearly such a system of assessment gives its owners no inducement to put it to its best use." The rating should be such as would induce the landlord to use it for building purposes. This, of course, should not be general, as it might do harm in one direction while doing good in another. Such rating may be good in the suburbs of over-crowded towns. After it is made possible to get land cheaply and affairs are arranged to manage matters economically, finance is needed for putting these schemes into practice. It is already pointed out that building investment is not so tempting as other investments, and it is difficult to get money for the purpose. To make the expense less by paying less interest

it is suggested that money should be obtained at 1 per cent. less from some public source than it can be obtained from private sources. It is on the last idea that such organisations as the Public Utility Society and Tenant Co-partnership Society are established and doing very good work. Those municipalities that are rich should also do the same. The Encyclopædia Britannica says : " It is seen that there are limits to drastic interference with the normal play of economic forces and to municipal action on a large and ambitious scale." In Germany a very fruitful source of supply of money is developed by the investment of surplus capital of the Old Age, the Infirmity Insurance and National Insurance Funds in these housing undertakings. To solve the difficulty of capital, Mr. George L. Pepler suggested that the Public Works Loan Commissioners " should reduce the interest to below $3\frac{1}{2}$ per cent., and extend the term of repayment beyond thirty years," and that it was " essential that the average interest to investors should not exceed 41/3 per cent." The landlord and the tenants both have certain economic facts to consider from their own point of view. The tenants' point of view is to have the maximum comfort at minimum rent whether rich or poor. The tenants consider the landlord a necessary evil, and the landlord looks upon the tenant as a desirable evil.

The landlord knows that land is a commodity that does not perish, and so he need not reduce his price to suit a slack market. If he is not in need of money he can keep it until the time when he thinks the maximum price at which it is worth selling is attained. To him this is just as much a business proposition as of

selling diamonds at the best price. The working people strike because they cannot sell their energy so cheaply. In the case of diamonds the commodity is not a general necessity, but in the case of land it may become a general necessity when the towns are getting overcrowded. So, looking from the point of view of the greatest good for the greatest number, the land must be acquired. Hence the arrangements should be such that the landlord gets a reasonable price and that on the other hand the price of the land should not be too exorbitant for housing purposes. Again, a house is a commodity that is consumed after about a century. A person who thinks of building a house or he who thinks of buying one does so with the object of self-amelioration, and so he likes to have what benefit he can and to be assured that the demand will continue. As the working classes are not capable of paying good rents, there is not much or any benefit to be derived from them by any small landlord. This is not sufficient reason why the landlords should suffer. To continue one of the demands depends upon municipal assurance that the locality will not be allowed to change its quality of investors to build houses for the working classes, exemption from taxes for 24 years is given to working class dwellings in Austria. This is not hard upon either the landlord or upon the people needing cheap accommodation.

In Belgium the working man was helped out in another way. Every working man who bought a house liable to registration fees from 72 to 171 francs got an exemption from personal, provincial and communial taxes. In addition he was helped out wonderfully by

an almost perfect system of railway transit. The housing reforms in Germany have three features which are more or less distinct. Firstly, the planning of extension is done in a systematic way. Secondly, there is the purchase of ground by municipalities for housing purposes. The third is the letting or sale of municipal land for building under prescribed conditions. Yet the best economic lesson to be learned from Germany is how roads that are too wide. "It was said that the Germans paid annually £60,000,000 more for housing than they would have done if it had not been for the curse of the over-wide streets." It is not an unpardonable deprivation to the owners to be forced to sell their land to some town planning body at a price fixed by the authorities. The landlords know from their present experience that to create a lasting value in their property they have to provide better conditions and make sure of the surroundings. This is very expensive and at times impossible. The town-planning schemes have that main idea. Mr. Pepler, referring to the town-planning schemes based on economicall ysound lines and with the security that the price of land will not fall, says about owners, "If they can do so and still reap as much reward from their enterprise, they are not likely to neglect the opportunity." It might be added, "provided all landlords understand that." Mr. Raymond Unwin worked out figures to show that "with 25 houses to the acre the tenant pays 7½d. per week rent for 127 yards; with 9.6 houses to the acre, if the tenant paid 1s. 0½d. per week, he could have 423 yards for his plot, and the landlord would make the same profit on his land." Thus there are some methods of

settling matters without being hard on the landlord or the tenant if both parties would give a patient hearing.

When the town-planning is of an industrial garden village or of garden cities, there arises the question of the adjustment of the claims of capital and of production. Mr. Edward C. Culpin says on this question, "It was proposed that the dividend capital should be limited to 5 per cent., and that all profits above this sum should be devoted to the benefit of the community, the land to be bought as a whole at agricultural prices and the freehold to be retained by the company." As there seems to be a clashing of interest between landlords and tenants because of the unreasonableness of both, the co-partnership housing scheme has been originated. The main principle of co-partnership housing is self-help applied by combination to the provision of superior houses. The chief important feature is the building of houses which are not only of good design and structure but also arranged systematically to utilise the land to the best advantage. In words of the *Encyclopedia Britannica,* "There is the common ownership of the whole group, which form a little community."

While considering urban housing, Mr. John H. Greenhalgh says, "We have two types of societies growing up: one in which the chief control centres with Co-partnership Tenants Ltd., which finds the bulk of the capital and all the initiative to develop the estate, and the other where the capital and initiative are provided locally, and in consequence the estate is locally constructed." Co-partnership housing has been successful and has proved itself to be a progressive system. On the whole, the present stage of town planning is

still experimental, and therefore self-sustaining societies are welcome to find out the different schemes and methods of town planning. The municipalities are expected to carry out town-planning schemes. The cost is resolvable into three main kinds. First will be the cost of the preparation of a scheme. This may be about £150-£200 for the first 1,000 acres planned and £100 for further development of every 1,000 acres. The second may be the possible compensation to be paid. Authorities do not think that this need be feared. On this point the following advice of such good authority as Mr. Harold Shawcross is really worth taking. "Local Authorities will in all cases be well advised to make their agreement with landowners before presenting their schemes for adoption, and if these agreements are signed and inserted in the schedule there should be no fear of compensation claim." Then again the authorities can always claim betterment on the whole.

The third question is whether the cost of administration will be increased or lessened. This should not be in any way higher. Besides, it will repay the extra cost, if it be incurred, by having less hospitals and asylums to keep up. Mr. Horsfall said: "Local Authorities had all along been paying ten times the amount they would have to pay under town-planning schemes, directly for street improvements, and indirectly through the Board of Guardians for sick relief, voluntary hospitals, and the public health service. That money could be saved if decent town-planning conditions were adopted." Mr. Shawcross has shown almost conclusively that town-planning from the municipality's point of view will have a credit balance.

LAYING OUT.

Several observations on laying out with regard to soils, dwellings, streets, etc., have been made at different places where they appeared to be quite relevant. In this section some others may be stated, with occasional repetition of certain observations previously made. In the Ruislip Northwood town-planning scheme the area selected was considered ripe for building because it was within a mile of one or other of the five railway stations around it. It is a sort of dual scheme having a general municipal place for about 6,000 acres which include 1,300 acres in the centre concerning which there is a detailed owner's plan to properly develop Ruislip Manor estate. The plan includes improved means of transit between the estate and main roads. There are other approaches provided to neighbouring towns and villages. The railway stations are conveniently accessible. The number of houses on a given area is limited so as to give plenty of sunshine, fresh air and garden space. Scientists made investigations and came to the conclusion that twelve houses to the net acre was a good limit if ample open space was provided and generously grass-lined roads were allowed. There should be an average of five persons to a house. The population should not be more than thirty people to a gross acre. It is desirable that there be a small playground in the vicinity of every home for children to run out to play for odd moments, or at the least some pleasant space where parents may easily take their children.

Encouragement should be given, or almost compulsion may be practised, to make every occupier of

a house keep a little garden in good condition. The houses are so arranged that the largest proportion has an approximate southern aspect. Adequate space is allowed for open places and public buildings. Attempts are made to group together the houses likely to be occupied by people of common tastes and approximately equal status. The objects of interest and natural beauty are preserved. The indiscriminate mixing of houses of different quantities and sizes is not considered advisable. Yet a well-balanced intermixing of a few small houses with large ones does not in any way depreciate the value of the large ones. The areas are scheduled for the erection of certain types of buildings. One area will be of dwelling-houses divided into different kinds. In others, factories and workshops will be forbidden. In the third, shops, factories, etc., which are not desirable in residential quarters are located. Regarding Frankfort town extension, Mr. Lunn says, "The town is divided into three districts or zones. In the inner zone, buildings with basement and four upper stories may be erected; in the middle zone, houses with basements and three stories are permissible; but in the outer zone, houses may not have more than two upper stories, and in small streets only one." The plan of Ruislip Estate is divided into four areas.

Area No. 1 has 3 houses per acre (gross).
Area No. 2 has $4\frac{1}{2}$,, ,, ,,
Area No. 3 has 8 ,, ,, ,,
Area No. 4 has 10 ,, ,, ,,

The average number of houses per acre works out at 12 over the whole district of 6,000 acres.

The allocation of land is as follows :—

Open spaces and timber preserved on	155 acres.
Road 60ft. wide on	27 acres
Road 40ft. wide on	125 acres
Road 40ft. wide on about	30 acres
182 acres.	
Land available for use	930 acres.
	1,267

This is the allocation of the estate of 1,300 acres. About one-tenth of the total area is laid out as open space. It is generally found difficult to maintain such a large proportion of area as an open space. The majority of town-planners are agreed that one-twentieth of the area will be ample for open spaces in the shape of parks, etc. It is found difficult to prevent such space being used by undesirable people. Alderman W. Thompson says on that account that it is "a very strong argument against throwing these lands open to the public." He also suggests "Strips of open space should be provided along the banks of the water courses, so that inhabitants may be provided with quiet walks along the streams."

As houses are spread over the land it is found economical to lay out many of the houses in closes or quadrangles having bye-paths or narrow roads of inexpensive type in order to reduce the charge per house for sewers, gas and water pipes, electric mains, and other public supplies, the cost of which depends upon the length or roadway per house. It may be added that a monotonous laying out throughout in a checker-board pattern is not very desirable. The result of such

a system in Melbourne is described by Mr. Charles C. Reade thus: "Melbourne tires one with its geometric repetition of design. It seems to have had all the ambitions, but realised few of the ideals of a truly noble city." Mr. Henry Vivian advises the Dominions beyond the seas "to make a special effort to guard against (1) the acceptance of a cut-and-dried pattern for their towns, whether it consists of squares, oblongs or circles, or any other shape of a set nature; (2) the adoption of the flat or tenement system as the standard home for the working people." Some data of the planning of a new town in Canada put forth by Mr. J. S. Dennis are: A band of land all along the length of the town. It must have a minimum width of 100ft. between the station grounds and the first avenue, which is to be laid out as a public park. A main street 100ft. wide to be at right angles to the park between the railway station and at the other end opening into a public square 600 sq. ft. The first two blocks on both sides of the centre street will be devoted to retail and general business. The balance of street to be boulevarded. The wholesale industries, factories and lumber yards will be localised on the outskirts of the town limit. Ample reservation to be made for recreation town. "Residential lots will generally face the railroad park and the avenues, with a few more desirable ones looking over the public square." In case of the extension of the town becoming necessary, about 100 to 160 acres are provided beyond the original area, so that it may be done systematically. Here it might be added that it is not necessary only to draw out a plan where a garden

city should be, but also to arrange beforehand regarding the limits to which it should expand. On this point M. E. G. Culpin says, "The idea in creating garden cities is to aim at towns with populations between thirty thousand (lower than which it would not be possible to go to enable the necessary provisions to be made) and sixty or seventy thousand (beyond which access to the country-side begins to be in danger)." The sewerage and water supply can be much better controlled by a town-planning scheme than has been done hitherto in other cases. It is often found in many towns that have grown up haphazard that sewers are laid on undeveloped land without roads, and thus expense is increased by way-leaves. In well-planned towns the sewers are taken along the lines of roads.

GARDEN SUBURBS, VILLAGES AND CITIES, AND TRANSIT.

No better authority can be quoted on garden villages and transit than Mr. Culpin, who defines them as follows:—"A garden city is a self-contained town, industrial, agricultural, residential—planned as a whole—and occupying land sufficient to provide garden-surrounded homes for at least 30,000 persons, as well as a wide belt of open fields. It combines the advantages of town and country, and prepares the way for a national movement, stemming the tide of the population now leaving the country-side and sweeping into our over-crowded cities. Garden villages such as Bourneville and Port Sunlight are garden cities in miniature, but depend upon some neighbouring city for water, light and drainage; have not the valuable provision of

a protective belt, and are usually the centres of one great industry only. A garden suburb provides that the normal growth of existing cities shall be on healthy lines; and when such cities are not already too large, such suburbs are most useful, and even in the case of overgrown London they may be; though, on the other hand, they tend to drive the country yet further afield, and do not deal with the root evil—rural depopulation."

Mr. Ebenezer Howard was the founder of the garden city movement. Though it originated in a hope to prevent the serious jeopardy to the proper carrying out of husbandry because the higher wages of manufacturing industries attracted the rural workers to towns "where at eighteen years of age a man was earning as much as he ever would earn as an agricultural labourer," yet it has solved some other difficulties. One of the most important problems was that of wages and available employment as already shown under the head of economic considerations. Again, though an industrial labourer could earn more in towns than an agricultural labourer in the country, yet the living in town is more expensive. An attraction to towns also existed in the facilities and varieties of amusements. Garden cities solve this difficulty by providing both town and country amusements. The selection of a site for a garden city is based on the principle that it should be sufficiently convenient to enable industries to be carried on, and still it should have the aspect of a country district. The use of the agricultural belt is also to limit the boundaries of garden cities, besides that of providing small holdings as farms and fields. Letchworth is a garden city, having 49 factories and workshops, 1,700 new

houses of which 115 were existing in 1903, 10 miles of new roads, about 20 miles of water-mains and gas-mains, sewers about 18 miles, electric light to the centre town, and more opportunities for social, educational, commercial and recreational pursuits than in towns. Its death-rate is only $4\frac{1}{2}$ per thousand. The garden villages are more for solving the difficulty of the housing of the employees of some grand industrial enterprise, by neither allowing them to subject themselves to town-overcrowding or to be forced to be affected by long daily journeys. To a certain extent it displays a hope for a higher standard of housing for families belonging to slightly upper ranks of the working people, as happens at Earswick. Such an industrial village is growing round Tata's Iron Works in India. The garden suburbs such as at Hampstead, London, aim at the same effect but for the employees of different manufactures in an over-crowded town, thus mainly solving the question of the housing of the neighbouring town employees. Cincinatus, at Karachi, India, is based on the same idea of a residential quarter for the middle classes. Lido near Venice is for the higher middle-classes, with its unique transit for ferries which take to economise the people's money by not wasting it on the work of omnibuses, and motor-launches replace motor-cars. Mr. Henry Vivian says, "The productive power of a working people with homes in tenement blocks will, I believe, be much lower than that of a working people having individual homes and gardens." It is easy to see the strength of this statement when it is perceived that living in country homes is healthier

than in town tenements, which must affect the industrial efficiency of workers. Living in neighbouring suburbs is made possible by electric cars and motor 'buses, and so they can be credited with having made it possible for working people to live a healthy life. Railways must be given their due for making it possible for people to live in distant suburbs and villages, and yet work in towns. But this is not favourably regarded by all town-planners. Mr. Culpin says, "Few people have realised the enormous economic waste involved in carrying workpeople to and from their work. Not only is much time wasted, but the conditions of workmen's trains are such that serious physical results must follow, and we are probably thereby laying up a store of nervous disorders."

Yet there is the other side to this question, as experienced in Belgium with its wonderful system of transit. An Antwerp docker, seeing that work was scarce, returned to his country house and did gardening, so did also the Brussels brickmaker, instead of fighting like an animal for some work that might crop up. From the country round Liege, 10,000 people came into the town to work, while its total population is only 160,000. There is little doubt that means of conveyance do affect the health in different ways. As the idea of town-planning is to promote the health of communities, it is necessary to see that these modes of communication do not undo what town-planning does. Most of the suburban tram-lines are insufficiently equipped with rolling stock, and therefore the open summer-car is used more often and longer than it should be. This is one of the causes of colds caught in late

summer. Again, street closed cars have the defects of being insufficiently ventilated and heated. Dr. Bashmore says, "To these cold cars have been attributed the undue prevalence of pneumonia occurring in some of the larger cities during certain periods of the year." For these cars a temperature of about 60 deg. F., will be desirable. Stoves are used in a few cases in heating street cars. These are not very efficient because the upper part of the cars may get warm whilst cold air is likely to settle round one's feet. Better results are given by electric heaters under the seat. Dr. Bashmore says, "The proper way would be to have electric heaters of sufficient capacity with a fresh-air inlet on the outside of the car, so that fresh-heated air could be furnished at the same time; and fresh air is sometimes sadly needed."

In railway cars ventilation and heating are mose defective. Yet the motion of the train, causing a draught of air, can generally solve the difficulty of ventilation; the only trouble comes when on account of the draft the windows are closed and the occupiers turn themselves into chimneys. On Pennsylvania lines new cars are successfully equipped with Dr. Dudley's method of heating and ventilating which "undertakes to furnish 60,000 cubic feet per hour for each passenger." The cleansing of the cars is not all that can be wished for, as seen in some of the cars running in the north of Scotland and certain parts of India. Cars should be washed at intervals with hot water and soap, and disinfected with formaldehyde gas or some other standard sterilising agent. Legislation should prevent the fouling of cars by expectorations, to which habit

the working classes are much addicted. The finish in the interior of cars should be of polished hard wood. The upholstery part should not be of cloth as seen in the cars of Scotland and tramcars of Liverpool, but of some non-absorbent material which is readily removable, something like oilcloth. Though we are not going into the sanitation of travelling, yet as these trains pass through and communicate with garden suburbs and cities, at least three facts should be mentioned. In sleeping cars some more readily washable material should replace blankets, because in the case of certain companies the blankets are washed only once in six months. Trains passing through garden suburbs and carefully town-planned districts, scatter excreta over the road-bed. This is both unsightly and dangerous. Dr. Bashmore says, "Some form of dry closet seems to me to furnish the best method of disposal having a galvanised pail with sifted coal ashes or some fine dry earth to the depth of four or five inches; this would be a sufficient deodorant and absorbent without any additional treatment until the end of the run." Drinking water is taken from taps of different districts through which a train passes, and so some of the bad water supplies can easily give disease to travellers, who may land in a garden city and pass it on to others free of charge.

MISCELLANEOUS.

In most of the great cities 90-98 per cent. of the poorer classes have no baths in their dwellings. This at once makes it clear that where a town-planner demolishes buildings and constructs new roads he will do well to use some of the finance and space in erecting

public baths. In fact every poor district should have public baths. Glazed fire clay, or as it is commonly called porcelain, baths are the best for public institutions. Tubs are not very desirable for public baths. A shower bath of some description is more hygienic, as the water once dirty passes away, while in tubs one has to remain in water which is constantly becoming more and more dirty. Dr. Bashmore says, " In a space 68ft. by 25ft., there have been placed facilities for bathing by rain-bath, 400 persons daily. To construct even a pool to bathe so many people would require one hundred times the space. The danger of transmitting contagious diseases is reduced to a minimum or rather abolished—a real danger in public tub-bathing unless the utmost care is observed and a great amount of labour expended." The town-planner of country districts should also consider bathing facilities. In the construction of houses one thing must be attended to, and it is that no pipes coming out from the bathrooms should communicate directly to the drains. It is desirable that all apparatus for heating water by gas should not be in the bathroom itself, as gas fumes are objectionable and dangerous. Besides, some baths are to a certain extent public institutions in great requisition from a curative point of view. On the authority of Dr. W. Hale White it can be stated that Turkish baths are very useful in helping the absorption of old inflammatory products such as are due to syphilis, chronic rheumatism, rheumatic myalgia and gout. People chronically poisoned by lead or mercury are benefited by Turkish baths. They help forward recovery in the cases of sciatica and neuralgia. Russian vapour baths

are useful in the case of chronic rheumatism, sciatica, neuralgia, and the dry form of bronchitis. Sand baths are good for chronic rheumatism, chronic gout and chronic Bright's disease. For chronic rheumatism, slime, peat, mud and moor baths are also used. Pulmonary emphysema, bronchitis, phthisis, and asthma can be beneficially treated by a compressed air bath. Electric baths are useful for rheumatoid arthritis and general exhaustion. This much should suffice to show that public baths should be considered as carefully as public libraries, in the planning of new towns and suburbs.

The other point of importance to be attended to is smoke. It is a bad plan to have garden cities and the smoke nuisance together. It is still worse in old large cities. The more the smoke the more waste of fuel is indicated. There are smokeless furnaces manufactures by Messrs. J. and P. Hill, of Sheffield. Again there are many smoke-consuming devices. It is only a matter of legislation to prevent smoke from spoiling the atmosphere and scenery of any district. On this ground the electrification of railways is a blessing. Several references have already been made to the psychology of the people. In all matters some consideration from that point of view is likely to help. It is a good plan to make people realise their responsibilities. Mr. Henry Vivian says, "The individual home with its individual garden is the nursery in a hundred unseen ways of thoughts and feelngs in parents and children, which go to strengthen that individuality and character without the possession of which you cannot have a great people. . . . It is upon this drawing out of the

individual's sense or order and beauty and securing his co-operation, that in the long run good town and estate planning depend for their perfect realisation." One quotation of Mr. Reade with regard to authority is worth stating : " It is now recognised by nearly all civic reformers that the abolition of divided authority is an essential step towards the promotion or orderly and better planned communities."

Lastly it must be stated that cremating is the best method of the disposal of the dead. The author has elsewhere propounded the plan that the ashes of the great men of every nation should, after cremation, be used for making tiny statuettes of these men, and that they should be kept in " La Nacia Musée de la Grandaj Mortintoj, i.e., The National Museum of the Great Dead."

Part II. Vegetation.

VEGETATION AND WATER.

Vegetation and water are inter-related, and so vegetation affects animal well-being through water in different ways. There are several kinds of vegetation which flourish in water, but still water is especially favourable to the development of the lower forms of plant life, like algae, which must be removed from drinking water. This can be done by screening and filtering. The water at certain seasons of the year becomes unpotable on account of the objectionable flavour, smell and appearance given it by algae and decaying vegetable matter. The waters from swamps and lagoons in which rushes grow sometimes have a disagreeable taste and objectionable appearance of a very persistent nature. In Mauritius this was a great difficulty in spite of the constant dredging, because the water had to be taken from a lagoon which contained immense quantities of vegetation. Such a difficulty had to be overcome in Singapore also. In the Proceeding of 1914 of the British Association for the Advancement of Science, Dr. T. Johnson quotes an instance in which a blue-green alga (Oseillatoria tennis var. natas) rendered a supply of water objectionable for domestic use, giving

it an oily, fishy flavour. It also puts filter beds out of order. One to ten pounds of copper-sulphate ($CuSO_4$) per 1,000,000 gallons removes this nuisance. Dr. Simpson says, "The plants which grow in the shallow parts of the tropical lakes mostly consist of a species of Chara, Utricularia Blysca, and Euhydrias. Chara has a disagreeable smell in its natural state, while the others cause the water to become offensive by their decay." Again, in some of the American storag reservoirs and lakes the water had a cucumber taste and smell which was due to a Spongilla fluviatilis, which is a minute fresh-water sponge. Nostoe and other Algae in a state of decay ase known to have given a pig-pen odour to water. A disagreeable flaviur is given to water also by crenothrise, cladothrix, dichotoma, and beggiatoa alba, and after filtration the water affected with these develops an offensive fishy smell. To get over the nuisance of such vegetation, Dr. Simpson suggests the following method :—

"In constructing new reservoirs it should be set down as essential, first, that the sides should descend rapidly to 12ft. to 15ft., and not slope gently to that depth, for with the fluctuations of the water level the latter condition is very favourable to the luxuriant growth of aquatic plants, and to their decay, both of which are to be avoided in providing a potable water; and secondly, that the whole site, including sides and bottom of the reservoir, should be cleared of bushes, scrub, trees, stumps of trees, peat, filth, loam and other organic matter, before any water is admitted into the reservoir." It is often noted that water coming out from forests contains too much vegetable matter. This

can be got rid of by filtering, or its harmful influence may be removed by boiling the water. In the tropics the water may get affected with the larvae of mosquitoes and crustacea. To combat these, suitable fishes can be introduced, but the same result can be effected by certain plants, like vallisneria, which gives off oxygen. Some vegetable juices containing tannin are useful for precipitation. The organic matter gets deposited, because tannin coagulates it. This is done with the fruit of strychnos potatorum which is used by some people of India, who rub it on the inside of their water-vessels. In other places tea and kino are used.

This shows that the effect of vegetation on water is not always bad. As a matter of fact sometimes the vegetable humus makes it antiseptic, which is a great necessity in tropical forest regions. Mr. Rochway says, "The rich brown humus in the swamps and sometimes in the river bottoms form a kind of peat called pegass. It consists of layers of dead leaves breaking into an oozy slime. This has the odour of the forest. In fact, both the pegass and the water which flows from it have antiseptic properties, which become of the utmost importance in the economy of tropical nature. This is the proverbial creek water, which if a stranger once tastes, he is bound to fall in love with the country."

Such creeks emerging from forests render it possible for plants other than trees to live and grow, so that in the heart of forests Victoria regias, eichornias, colombas, and ultricularis can be seen. Again, it is very advisable that the gathering-grounds in the tropics should be either natural healthy forests or should be planted with trees, where during monsoons the rains

are very heavy. The gathering-grounds which are devoid of vegetation and trees, during monsoons, give up immense quantities of silt. It is always important to avoid silt. Though the gathering-grounds should have plenty of trees and the right sort of vegetation, yet care should be taken that there should be no trees be nearer than 85 yards and not further than 110 yards. If the trees are right up to the bank sof the reservoir, then the leaves and branches add to the decaying vegetable matter and also make the filtering and purification more difficult. If there are no trees or they are too far, then in the Tropics, during monsoons, when it rains very hard the water falls direct on to the ground and runs down in torrents in the reservoir. This subjects the reservoir to much stress, and a great deal of water runs to waste. Vegetation and trees regulate a steady flow of water into the reservoir. For agriculture also it is of the utmost importance that the water supply should be continuous. The rain that falls on an open space or road runs off or dries up at once, but from a meadow the water takes much longer to drain. A rivulet that rises and flows from a wood is almost perpetual. At the same time, while selecting gathering grounds, one should avoid cultivated fields and swamps, and also bear in mind the probability of the increase and extension of the population of the town for which the gathering-grounds supply water. The area should not be inhabited.

The open channels used as conduits to supply water to reservoirs should be avoided, especially in tropical regions, because they are likely to get filled with weed and water plants, to make the channel

a breeding place for mosquitoes, and also to add vegetable organic matter to the water. At times, for the sake of economy (which is indeed a bad kind of economy), reservoirs are put in public parks and gardens, or gardens are made round such reservoirs. The grounds all around are made to slope toward the reservoir. The roads and paths around are subject to pollution, especially if such gardens have been the favourite resort for picnics. All the pollution left by picnic parties is washed down into the reservoir by the first shower of rain. The water of such reservoirs has been examined several times soon after such a wash-down, and has shown a marked increase in alluminoid of ammonia, chlorine, and bacteria. It is best to have wooded vacant and reserved land as gathering-grounds and to protect it efficiently so as to render contamination impossible.

TREES AND THE CONSERVATION OF MOISTURE.

Trees and forests are required not only for consideration as gathering-grounds but also for agricultural purposes, to conserve moisture and thus make the land habitable and also good for agriculture. When there are trees and forests a little distance from the sea they serve as barriers in the shape of great clumps of roots in the path of water, and thus prevent the rainwater from running easily into the sea. The roots have to be coasted, and so the water takes a tortuous course and thus fertilises a large area of land by making its irrigation possible. This can be well authenticated by the following statement of Mr. Rodway. "The field is

always drier than the wood, which can easily be proved by the dampness of the soil under a single tree. Even a hedgerow retains a large proportion of the rain which falls, and wherever there is a covering of soil the water runs off slowly, and is therefore more beneficial.'' This is demonstrated by history, which tells us that once, in parts of Egypt, Syria, Arabia, Persia and other ancient countries where rich vegetation flourished, the hand of careless man removed trees and vegetation to reclaim habitable ground to such an extent that the conservation of moisture became more and more difficult and eventually even impossible. Consequently these parts became deserts and once again uninhabitable on account of the other extreme of dryness. Spain during Moorish occupation was fertile in those regions which are barren to-day, because often the forests were not cared for but cut away.

It is well worth while quoting the following words of Sehleiden : "With the careless destruction of the growth of trees, man interferes to alter greatly the natural conditions of the country. We can, indeed, now raise one of the finest vines upon the Rhine, where two thousand years ago no cherry ripened; but, on the other hand, those lands where the dense population of the Jews was once nourished by a fruitful culture are in the present day half deserts. Rivers which formerly scattered their blessings with equal fulness throughout the whole year, now leave their dry and thirsty beds, to split and gape in summer, while in spring they suddenly pour out masses of snow, accumulated in winter, over the dwelling places of affrighted men. If the continual clearing and destruction of forests is at first followed by

greater warmth, a more southern-like climate, and a more luxuriant thriving of the more delicate plants, yet it draws close behind this desirable condition another which restrains the habitability of a region within as narrow, and perhaps even narrower, limits than before." It is not only through the conservation of moisture that vegetation helps in keeping a land fertile, but also by spreading a covering of silt which produces marked effects on the richness of a soil. When a meadow or a forest is flooded, a kind of filtering and depositing is brought about, and this wonderfully increases the richness of the country in contrast to the effects of torrentuous flow of water without any check to cause deposition and filtration. These remarks must not lead one to believe that water is always beneficient to vegetation.

Even here excess is ruinous. The discovery of bog oak timber under the layers of peat, show that water even destroys forests. Forest trees have power to continue to live for months even in the pools of water which cultivated plants. Forest trees are known to resist the effects of floods for six months, but most cultivated plants would be killed in a few days. Yet too much water flooding wooded regions for a long period has destroyed entire forests. This is one of the points which makes forestation very perplexing work.

The effect which plants produce on the atmosphere, giving back to it oxygen which is such a necessity for animal life, is known well enough to establish the interdependence of the animal and vegetable kingdom through the medium of atmosphere. Relieving the atmosphere of carbonic acid gas and refreshing it with oxygen is not the only good effect of vegetation upon

atmosphere. It also renders it more bearable, adding moisture to it, without which in tropical regions the atmosphere becomes very uncomfortable. The effect of vegetation in this regard is so great that not only atmosphere but even rocks become affected, as Mr. Rodway says, "Even bare ———— become hygroscopic in the shade, when those outside may be burning hot to the touch." Pettenkrofer calculated that an oak tree which had 711,592 leaves had from May to October an evaporation amounting to 539.1 centimetres, that is 212 inches, while the rainfall amounted to only 65 centimetres, that is 25.6 inches. Thus the evaporation was 81/3 times the rainfall. This shows how the atmosphere must have been cooled and moistened. There are other trees which do the same in a greater or less degree. The tree eucalyptus globulus is known to have evaporated eleven times the rainfall. Besides trees, other vegetation (even grass) does this. Mr. Rodway says, "There is a great difference between the amount of water distilled by grasses as compared with trees, but the former are by no means contemptible. Trees not only conserve moisture, but they drain the soil through every pore of their leaves. During heavy rains we can see that they are hard at work; new leaves are being put forth so that every possible effort may be made to find outlets for water which might injure the roots, if allowed to remain too long. Under the trees the ground is rarely sodden, but away from their influence this condition is indicated in Guiana by what is called the sour grass—paspalum conjugatum." This adding of moisture to the air becomes at times excessive in certain parts of the tropics. In tropical places having too much

vegetation a peculiar vapour is given off to the atmosphere which is quite appreciable to the senses of smell, taste, and feeling. The smell is like that of moist decaying vegetable, the taste is of a vegetable infusion. It has, as it were, a soft and sticky feeling. This always creates a desire for bathing. Besides the effects already stated, vegetation has the special action of sanitating the atmosphere of districts. This becomes especially marked in places where pine, camphor, and eucalyptus trees flourish in large numbers. The plan of sending consumptive people to pine districts has been known for ages, and is a proof in itself, but this point will be dealt with later on.

VEGETATION AND TOWN AIR.

The other side of the question, namely, the effect of town atmosphere on trees, is of importance from the point of view of tree plantation in town-planning. In new garden cities this does not become such a difficult question as in the town-planning of old towns. The atmosphere of old towns is full of impurities. The smoke and dust of towns affect trees in two ways : (1) by choking the pores of the leaves, and (2) by interfering with the sunshine that trees may get. The direct effect of smoke on seed-bearing plants is to decrease the size and weight of seeds, germination capacity and germination energy. The leakage from sewers and from gas-pipes give off gases which do harm to trees. During the modern days of electrification the town trees have a new enemy in the shape of electricity which sometimes escapes from lighting and other circuits due to imperfection of insulation. In those towns which have

manufactures giving off acid fumes, the trees find their worst enemies. Even if plants cannot be killed through the direct effect of gases, it is known that gases will affect the plants more than the fungii on them. This deterioration of plants makes them ultimately the victims of the fungii. Yet Mr. W. Rothwell, of Croft, maintains that there is a direct, bad effect on trees caused by bad vapour. He says, "Violent winds ruffle and break off the leaves of trees and shrubs and damage herbaceous plants, such as corn, etc., by breaking the stem, and thus stopping the flow of sap, and in the blooming season of any plant or tree, lessen or injure the crop for that year. But generally there is a clear distinction between damage done by a storm and that by a bad vapour. The latter shrivels and curls up the leaves, does not break them off or make them ragged. A storm never discolours the bark of a shrub, tree, nor makes it fast to the stem. Bad vapour does both." Mr. W. Rothwell gives the following list of plants in the order of the greatest susceptibility :—

A.—Forest Trees :

(1) Larch, (2) Spruce Fir, (3) Scotch Fir, (4) Black Italian Poplar, (5) Lombardy, (6) Ash, (7) Oak, (8) Elm, (9) Birch, (10) Alder, (11) Sycamore.

B.—Fruit Trees :

(1) Damson, (2) Greengage, (3) Halewood Plum, (4) Jacob, (5) Pears, (6) Apples, (7) Cherries.

C.—Shrubs, Evergreens and Wild Plants :

(1) British Laurels, (2) Portugal Laurels, (3) Aucuba Japonica, (4) Barbery Evergreen, (5) Hazel, (6) Guelder Rose, (7) Sloe Thorn, (8) Hawthorn, (9) Raspberries,

(10) Gooseberries, (11) Blackberries, (12) Gorse, (13) Hollies.

D.—Farm Crops :

(1) Potatoes, (2) Mangels, (3) White Clover and Rhubarb, (4) Red Clover, (5) Trefoil, (6) Rye Grass, (7) Wheat, (8) Oats, (9) Barley, (10) Common Turnips, (11) Swedes.

N.B.—Nothing is affected sooner than the common fern, the larch fern especially; marestail and gian fern also.

It seems advisable to add here the following list of plants, "according to the degree of sensibility to the noxious influences of acid gases," based on the reports of the official French and Belgian researches, because in this list there is not the classification of the plants but only the direct order of susceptibility :—

(1) Wych-Elm (Carpinus betulus), (2) Wych-Elm (Carpinus incisa), (3) Hazel, (4) Oak, (5) Beech, (6) Birch, (7) Sycamore, (8) Maple, (9) Willow, (10) Hawthorn, (11) Spindle tree, (12) Elm, (13) Lime tree, (14) Sloe, (15) Larch tree, (16) Bramble, (17) Ash, (18) White Poplar, (19) Italian Poplar, (20) Aspen, (21) Fuya Orientals, (22) Vine, (23) Plum tree sof different varieties, (24) Apple, different varieties, (25) Pear trees, different varieties, (26) Cherry, different varieties, (27) Currant bushes of different kinds, (28) Rose bushes, (29) Lilac (Syringa vulgaris), (30) Lilac (Philadelphins caronarius), (31) Raspberry bushes, (32) Meadowsweet, of different kinds, (33) Hops, (34) Alder.

The conclusions from the inquiries of the Belgian and French results are :—

(1) "Acid gases hurtful to a certain number of plants escape from a chemical work."

(2) "The effect is very unequal on the various ligneous and herbaceous plants natural or cultivated; some resist the acid gases to a considerable extent, whilst others are deteriorated by them in different degrees."

(3) "Of these latter, some cease to be affected at a small distance from the works, whilst others continue to feel the effect at a great distance."

(4) "The radius of the noxious influence of these gases depends on many circumstances, but it may be determined practically by observing certain plants such as the Wych-Elm."

(5) "Examined in this way the radius will be found to differ for every establishment depending on the dominant winds."

(6) "In the direction of the dominant winds the radius appears to be 2,000 metres at the most, and 600 metres as a minimum."

The best British authority on the subject, Dr. Angus Smith, does not agree as to the maximum radius of 2,000 metres, though he agrees on other points. Again, some of the tropical winds are so strong and enduring that in the Tropics this radius is likely to increase quite appreciably. A word of warnng given by Dr. Angus Smith in regard to drawing certain conclusions can very advisably conclude this topic. "If, for example, the leaves are broken, from whatever cause, the juice of the plant giving out hydrochloric and sulphuric acids, as chlorides and sulphates, presents a great difficulty. Many plants contain chlorides even on

the surface of the leaf, at a great distance from alkali works, and comparisons must be made with caution before drawing conclusions." All these remarks do not show that growing trees in towns is impossible, but only indicate the necessity for looking after them and for the right sort of planting to increase the health and age of trees.

VEGETATION AND CLIMATES.

If vegetation has an effect upon soil, water and air, it is not surprising that it should have an effect upon climate. Vegetation obstructs the sun's rays, and in cold countries evaporation is slow and the ground is moist and cold; therefore by removing an excess of vegetation the climate becomes drier and milder. Evaporation produces cold, and so in hot countries the great evaporation from vegetation causes a remarkable lowering of temperature. In addition, vegetation protects the ground from getting heated by the hot tropical sun. In the tropics the hottest and driest places are those that have no trees. Dr. Parkes says, "Herbage is always healthy. In the tropics it cools the ground, both by obstructing the sun's rays, and by aiding evaporation, and nothing is more desirable than to cover, if it be possible, the hot, sandy plains of the tropics with close-cut grass." The forests in the tropics become cooler by day and warmer by night than open country. Every kind of tree does not produce beneficient effects in the tropics. There the mangrove trees grow right on the edge of water, be it the coast of a sea or the banks of a rievr, and form a dense collection of spreading trees obstructing the sun's rays and

causing an extremely unhealthy climate. The mangrove forests flourish in conditions which are unfavourable to any flowering plant. The air they cause is so unhealthy that even natives of the country dare not venture to remain long in such localities.

VEGETATION AND RAIN.

Opinion is a little divided as to whether trees do or do not cause or draw rain-clouds, but the majority of people are inclined to take the affirmative view. Those who have travelled over the western countries of the great Hindi (Indian) Peninsula cannot but observe one fact, that those regions which are wanting in rich vegetation show every sign of the more or less absence of rain, while on the other hand those parts that are wooded show that they have plenty of rain, and that is actually so. Taking the two most important towns and ports on the western coast of Hind, Moombai (Bombay) and Karachi, this can be very well exemplified. Moombai has plenty of vegetation in it and in the country near, and so Moombai is a green town with plenty of rain; Karachi has but little vegetation in it or in the country around and so it is grey and without rain. The few trees all covered with dust and sand create a great desire in anyone with appreciation for nature to go round and give them a jolly good wash with Sunlight soap. Some of the evergreen plants there are never-green plants, but ever-grey plants. When it does rain in Karachi, there is a troublesome flood. Drought and inundation alternate in many parts of South Africa and Australia—where there are not any woods and vegetation. At times cattle and sheep die of thirst and starvation, while

at other times they get washed away by floods. The effect of clearing forests on rivers is to render them less navigable in the upper waters and to make the floods in the lower parts more serious. Besides this, Mr. H. Scott says, " The first result of the removal of the growing timber is the disappearance of the roots of the trees, which formed a network to hold the sail together. The rain falling on the bare hill-side sweeps off the earth with the loose gravel and boulders, and deposits it on the plains below, filling up the river beds, or at least producing serious shoals." There is no doubt that forests do somehow assure water and modify the extremes of drought and floods. Though it may not be definitely proved that forests cause rain, yet there is little doubt that local showers are often brought about by large areas of woodlands.

In a forest the effect of rain becomes more marked than in the open, even though the amount of rain on the woodland may not be more than on the open country. A field is drier than a forest. This is exemplified by even a single tree, the soil under which is less dry than that around it. In addition to all the natural evidence showing that forests do prevent drought, a little reasoning shows that rains may be caused by large areas of wood lands. Clouds may have passed over plains and may be pretty low. As they come over a wood land having tall trees like palms, or trees on some elevation, a similar effect may be produced on the rain-clouds as the slight agitation in water cooled below freezing point or of the strings put in syrup to assist crystallisation. Besides this, the matter of evaporation

is a reason for believing that trees have a great influence on the rainfall of a country.

It is calculated that the summer evaporation of a certain small forest in one day is equal to over an inch of rainfall on its whole compass. Mr. J. Rodway puts this thus : " The fact remains that trees are continually at work distilling water in enormous quantities. Given air already charged almost to the point of saturation, it is easily conceivable that the slight addition made when it passes over the forest will at once cause precipitation. Sometimes the dry season on the east of Guiana is prolonged, while not a day may pass in the forest region without a shower. Radiation from the sand lowers the temperature, so that vapour held in suspension may be precipitated by the difference of only tw oor three degrees thus produced. Such rains are generally accompanied by lightning; and sheet lightning is so common over the forest region in the dry season that it is looked upon by the residents of the coast as a sign of dry weather." Rain is good in many ways, but in towns it takes up acid impurities which it gives to plants and produces a bad effect upon them. Drs. Rustan and Crowther, in the proceedings of 1910 of the British Association for the Advancement of Science, state, " The relative high acidity of town rain especially in the industrial districts is injurious to grass and other vegetation. The reduced yield, lower protein-content and increased fibre-content of the grass grown under acid conditions is a matter of serious import for the farmer in semi-urban districts." The results of the experiments of Dr. Angus Smith corroborate the preceding statement, and are therefore quoted below. " By

a few experiments, not yet published, I find that one of acid in 50,000 of water destroyed all appearance of chlorophyll n some water plants in less than a fortnight. Sulphuric acid acted much more rapidly than muriatic. This was quite against expectation and general belief.

Another experiment showed that sulphurous acid had very much less effect than either the sulphuric or muriatic. . . . This was also quite unexpected. Why is muriatic acid most feared? The reason seems to be that it is driven off from the common salt with great violence and in great quantities at a time, so that it is more overwhelming in its attacks than sulphuric acid, whilst on the other hand it unites with water and does not disperse so readily as sulphurous." Rain and climate have an effect on the beneficial oil evaporation of the eucalyptus trees, which is described by Baron von Muller as follows: "The evidence of oil evaporation might thus be stated—that the desert scrub gums, after a winter of average rainfall, supplied the air with a continuous and even quantity of aromatic vapour, and kept up a rigorous vitality throughout the summer, and that a short season of rain and a long, dry summer diminished the formation of oil, and so lessened the exhalation; but, on the other hand, the species tending seaward increased their quantity after a short winter."

TREES AND HEALTH.

The preceding remarks must have made the relation between trees and health quite apparent. The evaporation of the essential oils of different kinds of trees and especially of the eucalyptus, camphor, pine,

and sandal-wood produce a sanifying effect on the atmosphere. Emanations from eucalyptus, camphor, and sandal-wood trees are not onl yaromatic and pleasant but they are deodorant and useful almost to the extent of being nature's disinfectants. It is recorded in the 1914 proceedings of the British Association for the Advancement of Science, that the cluster pine (Pinus Pinaster), under the name of maritime pine, transformed the dreary malaria-stricken Landes in Southern France into a healthy, habitable country. The endemic fever in the most unhealthy parts of Algeria is known to have been perfectly annihilated by the plantations of eucalypti. The use of an infusion of leaves of the trees is efficient "even in many cases where quinine is said to have been administered in vain." Eucalyptus globulus trees have the power of destroying the miasmatic influence of marshy districts. The comparative freedom of Australia from violent malarious endemics or miasmatic poison is due to the eucalyptus plantation. Mr. Bosisto says, "Of the whole indegenous vegetation of the Australian Continent, which is 2,500 miles west to east, and 2,000 miles north to south, and in area amounts to some 3,000,000 square miles, the eucalypti, numbering 150 kinds of species, form four-fifths"

The Italian Government soon took a lesson from the good experience of other countries, and to combat malaria in districts stricken with it, supplied land-holders with large quantities of slips of the trees for forming plantations. Mr. Kingzett says, "Malaria fever is an infectious disease, the poison of which may be conveyed in the air and in water, and in order to obtain general protection against attack, it would be necessary not only

to have plantations of the eucalyptus covering the whole area under observation, but also to shut oc contamination from exterior sources. The eucalyptus certainly gives some protection even if absolute immunity cannot be claimed for it." It is not necessary that a district must be affected by malaria or any such disease before the healthy effects of these trees can be realised. On mountain tops and hilly slopes where there is no water-logging and no malaria, woods of pine trees and groves of eucalyptus are found to flourish, and their hygienic effects are as marked there as anywhere else. There is a good variety of the species of eucalypti, and so some can be found which are able to flourish, or at least live, in all sorts of climates from the tropics of Hind (India) to the temperate regions of England. It is not possible to rear the eucalyptus tree in England, though fully-grown trees, if looked after, may live.

The best tree to be planted in malarious districts is eucalyptus rostrata, because it will grow in periodically flooded places and even in stagnant water, if it be salty. This is one of the poorest in oil. Pine is distributed in nature more extensively than eucalyptus and so it has a more beneficient influence. Camphor has been known for ages for its good medicinal antiseptic properties, just the same as turpentine and sandal-wood oil. The evaporation of these substances from their trees naturally produces a good effect on the atmosphere. Mr. Kingzett explains the probable manner in which this effect is produced thus: "This protection is to some extent due to the essential oil which is given off in a vaporous condition from the trees, but mainly to the

products of its atmospheric oxidation in presence of moisture, and no doubt it is also due in part to the action of the trees in absorbing water from the soil. The shoots of the raats throw out thousands of thread-like fibres, forming a dense sort of woolly mat, which suck up a great quantity of water, and that which is not utilised in the rapid growth of the trees is ultimately evaporated with the essential oil from the leaves. I am sure that the sanitary properties, and therefore probably the medicinal virtues, of these oils are to a considerable extent dependent upon the hydrocarbon (terpene) constituents, because it is from their oxidation in the presence of moisture that the peroxide of hydrogen which results from that process is derived." Peroxide of hydrogen can easily give off some oxygen, and so the presence of additional free oxygen is one of the ultimate causes of the good effect. The members of the coniferae have turpentine in their wood, bark and leaves, and during the flow of crude turpentine there forms upon the bark a concrete mass of it, and atmospheric influence evaporates the volatile oil from it. The practice of sending patients suffering from pulmonary affections to pine forests is quite a scientific and efficient one. Mr. Kingzett says that in camphor forests, "as in those of pine and eucalyptus trees, which we have previously considered, atmospheric oxygen i sconstantly being absorbed by the essential oils that are continuously evolved into the air, and this simple process gives rise to the production of a number of active chemical principles including peroxide of hydrogen, a thymol-like substance, and soluble camphor, all of which purify the air and enhance the health-

ful influences of the climate." The comparatively small amount of illness amongst the Parsees of Hind (India) is due partly to the habit of burning sandal-wood and incense and fumigating the house every day, though mostly to the hygienic ways of living. Those who are not convinced of the good effect of pine, eucalyptus, and camphor trees on health, or those who wish to know more on this subject, cannot do better than read *Nature's Hygiene,* by C. T. Kingzett, the champion of health forestation.

VEGETATION AND DISEASES.

Te prevention of malaria, phthisis, etc., by vegetation shows only one side of the question, because vegetation may be blamed for bringing about various diseases. Reference has already been made to the vegetable growths which through drinking water may cause diarrhœa, but the effects of the internal use of herbs and plants can hardly be dealt with here. Bacteria have up to now been looked upon as vegetable organisms and the cause of a great number of diseases. There are several vegetable parasites which produce illness internally or subcutaneously, like the cotton ferugus disease which come in the realm of vegetables and pathology. Yet those vegetable parasites which cause illness on the surface of the body can be relevantly touched upon here. These are actimonycotis by streptothrix actinomycotica, mycetoma from streptothrix madura, head-ringworm by tinea tonsurans, body-ringworm by tinea circinata, beard-ringworm by tinea sycosis, pityriasis vericolor by microsforon furfur, favus

by achorion schonleinii, and erythrasma by mimitissimum.

The means of prevention of all such diseases and scabies is to keep the body clean by systematic general ablution. Agricultural garden-city people will do well to provide cheap and clean public baths. Farmers and agriculturists are not particularly fond of bathing and washing themselves, hence bathing must be greatly facilitated. Irritation of the skin is often caused by harvest-bugs and insects. Stinging nettles and other stinging plants cause considerable cutaneous affection, but this is of temporary character. All farmers and most agriculturists have a great deal to do with animals, and contract contageous diseases through contact with animals who mostly develop them from vegetation directly or indirectly. Those milking diseased cows often get scarlatina and also ringworm. Several foot and mouth diseases are often caught from cattle, and glanders by contact with horses. Though agriculture is the healthiest occupation, it gives its quota of disease. Dr. Arlidge says, "When we look to the condition of old outdoor farm-labourers we find few unaffected with chronic rheumatism or with its congers, sciatica, lumbago, and rheumatic arthritis, or else with chronic bronchitis, and a considerable ratio of heart-disease." This appears to be altogether occupational. Though it is mostly so, there is a slight relation with vegetation, as is evidenced by the following observation of Dr. John Taylor, a practitioner in an agricultural district: "The disorders of the respiratory organs and phthisis are most rife from the end of October until the end of April, a period during which the

atmosphere is foggy and damp and charged with emanations from the debris of fallen leaves and dead vegetation."

The diseases caused by any kind of food can be better dealt with in a treatise on food in relation to health and disease, yet there is an aspect of this subject which seems to be relevant from the town-planner's point of view, and so is just briefly touched upon here. In spite of the suggestion that bovine tuberculosis is different from human tuberculosis, the fact remains that human tuberculosis is often caused by bovine tuberculosis, even if as indirectly as to say that the milk and flesh of tuberculous beasts are not nourishing enough and by causing weakness create a susceptibility to the inroads of tuberculosis. The majority of inquirers believe in a nearer relation between the bovine and human tuberculosis, and therefore that point of view is taken here. Bovine tuberculosis may be caused directly or indirectly through the vegetation the beasts eat, leading to impoverishment of their system due to the want of some substance. Mr. E. F. Wright has shown that diseases like red-water, heart-water, fluke and tuberculosis in sheep and cattle may be related to the absence of iron in the herbage on which the affected animals live, and so he concludes that manure pastures with iron have stopped and will check to a great extent these diseases. He says, "Manure the land with iron, phosphates and potash, and I am sure the predisposition to tuberculosis in dairy stock will be removed. And there is no question that if you remove bovine tuberculosis, you remove a big factor in human tuberculosis." It is apparent that one of the most important steps to take

for the prevention of consumption is to guard mankind from chemically defective or pathogonically infective food, consequently such scientific methods of agriculture, as well as other precautions, should be made certain. Mr. Wright has shown the relation between the absence of iron in the soil and the animals living on the products of such soils, and says, "If you have a field rich in all the essential mineral constituents, in an assimilable form, and a green crop be grown in this field and ploughed in, and then a cereal crop be grown, this cereal crop will be immune to rust, to say nothing of other parasitical diseases." Medical researches in the tropics have shown a relation between beri-beri and the use of rice as a staple food. But Mr. Wright connects the prevalence of even leprosy with the use of too much rice. "This seems to be accounted for by the following facts, that rice is notoriously deficient in mineral matter and nitrogen, or in other words, the substances which ordinary crops take away from the soil. I do not, of course, say that rice is incapable of taking up the required minerals, but that the paddy fields having remained unmanured for hundreds of years, the soil has been exhausted of those mineral constituents. Proper manuring would in all probability render rice a more wholesome food than chemical analysis shows it to be at present." Though this hypothesis needs further proof before it can be accepted, yet the suggestion is worth consideration, because all the attempts at creating pleasant surroundings in a garden-city will be frustrated if the too free use of impoverished rice cultivated in the agricultural belt of a garden-city gives susceptibility for creating several leprous inhabitants. It

may be of use to have a table showing the iron proportion in the main cereals, and the following table is quoted from the *Dictionary of Chemistry* :—

In wheat	Fe. 203	ranges	between	3.3	and a trace.
,, oats	,,	,,	,,	5.1	,, 0.1.
,, barley	,,	,,	,,	2.1	,, 0.1.
,, rye	,,	,,	,,	2.2	,, —--
,, maize	,,	,,	,,	0.8	,, 0.5.
,, rice	,,	,,	,,	0.0	,, 0.0.

Mr. Wright also shows the relation between cancer and deficiency in iron, and argues, " We have a distinct statement that there is a deficiency of oxygen and that there is anæmia in those suffering from cancer, so that in such cases there is a deficiency of iron and nitrogen in the blood." Here it might be added that the disease of impoverishment in vegetables may be caused by lack of manure, yet too much manure can even kill vegetation. The orange tree is the easiest to kill by over-manuring. It might be added that the jungles of the tropics are at times blamed not only for being the focii of deleterious miasma, but even the indirect causes of cholera, which becomes slightly difficult to believe.

VEGETATION, MALARIA, AND YELLOW FEVER.

The use of too much rice by itself as the main article of food may cause these diseases, but rice plantation is often considered responsible for malaria. The medical men in the tropics object strongly to habitation near rice plantations, and justly so as far as circumstantial evidence goes. This led Dr. Kennard to put

down the following laws of health with regard to rice plantation :—

(1) No settlement should be allowed in the rice fields.

(2) No rice fields should be within 200 yards of the houses to the leeward, or within a quarter of a mile to the windward. The anopheles is not a strong flyer, but is said to be able to travel at least over 100 yards. In Italy, I believe, there is a law preventing rice fields near the houses.

(3) The trenches connected with the rice fields should be kept clean and free from weeds, and the excess of water be properly conducted away from the fields and not swamping the surroundings, as is frequently seen and is one of the worst features in the rice fields near the villages; some of the villages are kept in a bad state of drainage or irrigation owing to this, and thus local foci for anophiles breeding may be developed and kept up.

(4) The rice should be planted in each field or fields under the same common drainage or irrigation at the same time, so that it would be reaped at the same time, and the water would be regulated accordingly; thus there would be fewer pools about, and these would exist during short periods.

(5) At the time of reaping, everybody working in the rice fields should take a daily dose of quinine; and in the rice settlements, if not abolished, they should commence this earlier and continue for a little time after the rice-reaping.

These rules are almost standard in their way, although

it should be stated that all rice fields are not malarious. The malaria that prevails in the neighbourhood of rice fields is due often to bad irrigation, because rice fields do not require such attention for crops as would be unfavourable to the breeding of mosquitoes. In fact this can go so far that if ravines be converted into cleanly rice fields, then malaria lan be removed. In British Guiana one kind of the most dangerous malaria spreading anopheles was driven out by controlling the irrigation, drainage, and water supply. It might also be borne in mind that the Eastern people, with such a great amount of resignation in God and Fate, cannot very easily be persuaded to take quinine or any other kind of drug when they are not actually ill. Messrs. Stewart and Proctor showed clearly that there was a close connection between the intensity of malaria and over-vegetation.

A definite connection is traceable between malaria and anopheles umbrosus, which is its carrier. This mosquito breeds in stagnant pools. So the spread of malaria could be controlled by draining and cultivating the land, thus abolishing such breeding places. Drainage renders it possible for air to permeate the soil, which promotes the oxidation of organic matter and so makes the places less congenial to anopheles habitation. The species that enter houses and carry malaria do not oviposit in water contained in tree-holes and stems of plants as other mosquitoes do. On this account in some parts of the Isthmus of Panama it was not considered of great importance to prevent their breeding. In other places such breeding places were considered dangerous. Messrs. Le Prince and

Orenstein give the following good description of such breeding-places : " At Cristobal, in that part of the tidal flats covered by high tides and by excessive tides, larvæ were found to be numerous wherever clearings were made and leaves remained in the water. Clumps of plant stems afforded hiding-places to the larvæ of anopheles albimanus and anopheles tassimaculata, even when small fish were present. Invariably larvæ were most numerous where the fallen leaves were most plentiful. These leaves were about eighteen inches wide and four feet or more in length. In the swampy area in the Rio Grande valley, the percentage of salt water varied wit hthe tide and rainfall. Anopheles albimanus was the prevailing species. The detp water contained many mangrove trees and drift from upstream, while the more shallow water was well covered with grass, dead leaves, and plants that thrive in brackish water in the tropics. Larvæ could always be found in untreated portions of this area where there were sufficient hiding-places." Grass is a potential harbour for mosquito colonisation, yet grass by itself is not very dangerous. When grass hides debris and when dirty water is emptied in tall grass, anopheles find an ideal abode. This is why high grass round about houses should be removed so that it may not be used as a filth receptacle. In the vicinity of dwellings, wet cultivation should not be allowed. Wet cultivation carried out with hygienic care is not so bad as uncultivated moist soils whch are not properly drained. Water-holding plants are not desirable in the vicinity of houses, and many authorities looq upon them with suspicion, but Messrs. Le Prince and Orenstein

disagree. They say : " Discussion has arisen at intervals regarding the advisability of destroying water-holding plants such as banana, alocasia, etc. We are inclined to believe that danger from these plants has been greatly over-estimated. It is possible that larvæ of aides calopus may have been found in them, but careful observation in Cuba and on the Isthmus of Panama has convinced us that fully-developed larvæ or pupae of this species seldom occur in these water-holding plants, and that the banana plants are unimportant in producing them." These water-holding plants are suspected of breeding not so much the mosquitoes of malaria as of yellow fever. The Army Medical Board at Havana has proved " that yellow fever is capable of being transmitted by the female of the mosquito now known as the aedes calopus." Some of the European officials sent to the tropics to do the work of sanitation do just the contrary, because they wish to have the maximum salary for minimum work and maximum efficiency with minimum effort. They consequently put unnecessary duties on the shoulders of those Europeans who wish to do an honest amount of work for their salary and who take a humanitarian interest in their work.

This can be authenticated by the following words of such practical authorities as Messrs. Le Prince and Orenstein : " It is surprising how many mosquitoes are unnecessarily brought into existence by people who are aware that the construction work they are doing will cause anopheles to multiply. They do this even when it would cost no more to arrange for proper drainage. Borrow pits or excavations are made where they

tap seepage water planes, and are sometimes left to collect water, in places where they cannot be drained." Ventilation is of importance in preventing bad forms of malarious outbreaks. If ventilation is interfered with by vegetation in a place where moist and decaying over-vegetation remains in a stagnant atmosphere, miasmatic poison is likely to exist in a dangerous degree. Ravines and mullahs should be avoided for habitation, because in the tropics they are dangerous through decaying over-vegetation. Dr. Parkes says: "On plains the most dangerous points are generally at the foot of hills, especially in the tropics, where the water, stored up in the hills and flowing to the plain, causes an exuberant vegetation at the border of the hills." All these statements have to be taken as not without exceptions. During some of the anti-malaria work done in the Federated Malay States the workers met with failure where it was least expected. On some healthy-looking hills without swamp and with crystal water from springs and streams, anti-malaria work completely failed. The reports of the Commissioners to the Royal Society investigating malaria in India, and published in 1902, showed that "intense malaria was often found in the hills, while the plains were not necessarily malarious. The prevention and control of malaria can be done on the following simple principles:—

(1) The habitations should be removed from half to one mile from places suspected of having miasmatic poison like jungle pools.

(2) No water-bearing plants, wet cultivation and rice fields should be in the vicinity of dwellings.

(3) Suspected fields and meadows should be irrigated, cultivated, and good drainage and water control made.

(4) Those people living near dangerous localities should be encouraged in, and taught the use of, quinine.

(5) Suspected pools, if not removed, should have a covering of petroleum oil, and fish life should be promoted.

(6) Infected or suspected places should be cut off by a sheet of clean water or a belt of trees from inhabited quarters or by both.

(7) Right kind of trees like the pine, eucalyptus, camphor, and sandal-wood should be planted both in the inhabited and suspected regions.

(8) Unhealthy woods and jungles should be cleared if necessary in spite of the armchair criticisms of naturalists which only show that the difficulty of dealing with tropical forests and jungles are not fully understood. Here it should be noticed that Major Perry has found that whilst the proper clearing of jungles at 2,000ft. plateau gives hopeful results in practical eradication of malaria, yet conditions at 3,000ft. plateau are so different that no appreciable difference is produced. It is not to be understood that the practice of some Europeans of thoughtlessly destroying tropical forests for the sake of mere show of easy efficiency for drawing large salaries is to be encouraged. Messrs. Le Prince and Orenstein advise that "the destruction of ornamental and useful plants causes opposition, and we would urge that,

before the wholesale destruction of these plants is undertaken, very careful observation be made to determine their true importance in the propagation of this mosquito."

(9) Though tall grass serving as receptacles should be removed in the near vicinity of houses, yet it is herein urged that when it is made sure that piping will not fail and grass will not have to be weeded, grass should be actually grown. In Kuala Lumpur the growing of grass on hygienic lines actually helped in the success of anti-malaria work.

AROMATIC ASPECT IN SANITARY GARDENING.

Eucalyptus, pine, camphor, sandal-wood trees are plants the hygienic effects of which are very remarkable, but even smaller plants which give out fragrance on account of the essential oil which they secrete produce similar effects, but not in such a marked degree. Such plants are mignonette, sweet verbena, jasmine, rose, lavender, acacia farnesiana, heliotrope, rosemary, peppermint, violets, wallflower, laurel, orange, marjoram, and valerian. All these, excepting the last two, grow exceedingly well in Australia, just the same as eucalyptus trees.

Camphors have sanitating properties, and therefore rosemary, marjoram, lavender, sage, pansy, semen-contra, and valerian, from the essential oils of which substances such as camphor can be obtained, may also have hygienic properties. The fragrance from flowers and plants are at least deodorants, but in some cases are the disinfectants of nature. There

is much truth in the words of Mr. McDonald, who says, "The refreshing odours prevalent in a garden where the richest perfumes shed their aromatic perfections lavishly around, are the spoils from Nature's laboratory, that dispense delicious medicines to sweeten our existence."

Plants like eucalyptus, camphor, pine, sandalwood, lavender, musk, sunflower, mignonette, cherry, laurel, clove fennel, narcissus, heliotrope, hyacinth, etc., increase the quantity of ozone in the atmosphere around them under exposure to the sun's rays, and so there is no wonder that such fragrant plants produce a sanitary effect. The fragrance of mignonette at times has been considered sufficiently powerful and antiseptic to protect people living near it from such effluvia as may bring disorder in the air. Mr. McDonald says, "It is not yet fully appreciated in England, although well known from experience in the East, that perfumes, vegetable scents, and sweet odoriferous plants possesses energetic antiseptic qualities, and possibly some clue to these properties resulted in the origin of the burning of incense in the early days, to lessen the spreading of diseases of an infectious character. Medical researches of recent date have resulted in the discovery that floral perfumes have a positively healthful influence on the atmosphere, converting its oxygen into ozone, and thus increasing its oxydising powers." It is not undesirable to quote yet another authority, Dr. Lindley, who says, "Until the prejudice is entirely removed, the fact cannot too often be repeated that, instead of plants vitiating the air, they do a great deal of good by producing a large quantity of

fixed air, and thus play a most important part in the economy of Nature by purifying and rendering wholesome the deleterious air breathed by animals.'' The fragrance of flora odorata is not always so feeble as may be imagined by people who have not experienced their effect en masse. The odour of the Flower of Flowers (Ylang Ylang), of the Indian Archipelago, is so powerful that for miles the air around the trees is filled with its scent. The Syringa family of Californian flowers fill the air with perfume for a long distance. These cannot vie with the fragrance of the flowers of Ceylon which is borne upon gusts of winds to people on boats far out in the sea. For many miles in the Mediterranean seas the sweet smell of the flowers of the South of France is wafted on the balmy breeze. The inhalation of the air filled with the emanation of the sweet Bay was considered such a sure preventive against the infection of plague during the Italian plague that people from Rome were advised to go to San Lorenzo, where sweet Bay grew abundantly. This is quite enough to show that town-planning authorities should encourage people to grow fragrant plants in their gardens in preference to others grown haphazard, so that if there be not the beauty of systematic colour science, yet there would be the hygienic effect of sweet odour. In public gardens and parks this should be made a special feature above any other, if these places are to be open-air sanatoria.

It should also be borne in mind that though fragrance has beneficial effects in open spaces, yet its effects in enclosures are not definitely proved to be good. Most authorities object to fragrant plants in sick-rooms,

which is quite understandable in the cases of the night-smelling Stock, the Tube-rose, the Narcissus, etc. Yet most people have experienced the soothing effect of eau-de-Cologne, which is mostly distilled from the leaves of orange plant. Even such an authority as Florence Nightingale has shown favourable inclination towards the use of growing plants in sick-rooms. The best rule is to let the plants, in small, suitable numbers, remain in the room during the daytime if desired by the patient, but to remove them a tnight-time in any case. Artificial perfumes cannot be regarded as so wholesome as the natural fragrance of flowers. Several scientific people have shown the probability of harm to throat and eyes through the too lavish use of scents, and some have forbidden singers to have anything to do with flowers. There is a likelihood of such harm, and so perhaps is advisable to use such things with caution. Dr. Gougenheim, a hospital physician and a lecturer at a Conservatoire, refers to cases in which an ill effect is produced by scents, but he believes that such phenomena may probably be nervous ones. However, as the good effect of sweet odoriferous plants is certain, all inhabitants of garden cities should grow them.

There are over 640 plants that are odoriferous, so that it is quite apparent that with such a large choice there is no excuse for any private garden not being arranged with fragrance as the main feature. Some of these plants will give some good essential oils as perfumes. Indeed, it is a very pleasant occupation and recreation for young generations to extract perfumes from home-grown plants and thus get a good education in practical chemistry. There are about 640 such

plants, some of which are suitable for almost every garden in every climate.

CHROMATIC ASPECT IN PLANTATIONS.

The colours in nature as a rule come in such combinations as not to produce a displeasing effect. Yet artificial gardening often leads to the mixing of such colours in flowers as to produce inartistic results when the flowers are in large collections. In those cases where blooms grow on large plants with plenty of foliage such a difficulty is automatically solved by the effect of green foliage as a background. Even in such cases it is worth while taking precautions against distressing chromatic accidents. It will be beyond the scope of this work to go lengthily into landscape gardening, nor will it serve any useful purpose, as plenty of literature on the subject is already published. A recapitulation of mere chromatic principles is all that is wanted here. The flowers that produce pleasant effects in association with one another are of colours complementary to one another. The main complementary colours are green and red, orange and blue, greenish yellow and violet, indigo and orange yellow. The shades and hues in the same degree of intensity of these colours will also form pleasant contrast. The tonic effects of delicately-coloured flowers can be heightened by the association of white flowers. White flowers may also be useful in dividing the masses of such flowers as have colours which produce a disagreeable combination. White flowers agree well with a collection of blue and orange flowers. Orange-yellow flowers agree well with blue flowers, but greenish-yellow flowers accord well with

bluish-red flowers. If the colours resemble one another, then the beauty of each colour is not brought out when they are in association, and so—

Pink flowers should be separated from Crimson flowers,

Blue flowers should be separated from Violet-Blue flowers,

Orange flowers should be separated from Orange-Yellow flowers, and

Yellow flowers should be separated from Greenish-Yellow flowers.

As a rule the best effects are produceable by the association of only two colours. More than two colours require very great care because the taste on multi-coloured combinations differs widely, and so the chances of producing unpleasant effects are more than in a combination of only two colours. Blue and red in combination displease many people, yet deep blue and deep red flowers accord well, as do very light blue and pink in balsam blooms. When more than two colours are desirable, white, black, grey, brown, and sky-blue are the safest to employ. If a repetition of more than two colours is wanted, two complementary colours with either white, black, grey, brown, or sometimes sky-blue will produce better effects than four or five colours. When five colours are wanted for repetition, any two complementary with three of the innocent ones mentioned will serve well. Just as the repetition of accented and unaccented syllables produces the pleasant sensation of rhythm in verse, so the well-arranged repetition of colours also produces an agreeable sensation which can be helped forward by judicious repetition of form. That careless growing of flowers can

really be displeasing is borne out by the following classical statements of Chevreul, the father of systematic chromatics.

"In a linear arrangement, for example, there is nothing more unpleasant than the blue flowers of the German iris, associated with the light violet of the lliac. But if we add to this associaton large tufts of alyssum saxatile, Persian iberis, and red tulips, so that the golden yellow, white and deep red, appear on one plane, and the deep blue and the light violets on a more distant plane, we shall obtain general effects of a most agreeable kind. Diversity of colours, pushed to the extreme, can only be permitted in a continuous border, or a bed of different varieties of the same species of flowers, as a border of larkspur, china aster, or anemones; but for flowering shrubs, we shall gain everything by not indefinitely multiplying their colour, in a view which the eye can embrace at once. And as with colours so with forms, which must not be too diversified in the same arrangement. If there exists a subject worthy of being studied critically on account of the frequency and variety of the cases it presents, it is unquestionably this; for whether we contemplate the works of nature or of art, their varied colours form one of the finest spectacles man is permitted to enjoy." One fact about private gardening that is worth mentioning is that great assistance can be rendered to plants producing coloured flowers by giving iron manure. The result of this is to improve the brilliancy of the colours of flowers. It is also advisable that home-grown vegetables should also be sufficiently manured with iron.

MASS PLANTING.

The whole field of tree-planting cannot be dealt with here, but a few useful facts from the town-planning point of view will be given. Eucalyptus trees are fast-growing and can free vast tracts of country of malaria, but other fast-growing trees do not do so. The varieties of eucalyptus are : (1) eucalyptus globulus, (2) eucalyptus amygdalina, (3) eucalyptus oleosa, (4) eucalyptus sideroxylon, (5) eucalyptus goniocalyx, (6) eucalyptus obliqua, (7) eucalyptus odorata, (8) eucalyptus rostrata, (9) eucalyptus citriodora, (10) eucalyptus corymboza, (11) eucalyptus dumoso, (12) eucalyptus fissilis, (13) eucalyptus longifolia, (14) eucalyptus viminalis, (15) eucalyptus mannifera. Of these, the one used most is eucalyptus globulus, because it grows very quickly and because the boiling range of its oil is comparatively low, being between 144 deg.-177 deg. C. The one that is the most useful is eucalyptus rostrata, because it is perhaps the hardiest and can grow in places unfavourable to the other species. The boiling range of the oil of rostrata is greater than that of globulus, and begins even lower, being between 131 deg.-181 deg. C. These two are not the richest in oil.

Eucalyptii have an ever-green foliage, which is not scanty nor so luxuriant as of other tropical trees. They shed their bark annually, but not at a regular period. This should help eucalyptus in flourishing in towns where the smoke and other impurities choke the pores of the bark, because the affected bark is annually dropped. The stems on this account always appear ragged. It is said that from only one pound of seeds of eucalyptus 160,000

plants can be grown. M. Valles showed that "a square yard of leaves of the globulus weighing about 2¾lbs. gave off 5lbs. of water by evaporation in twelve hours." Eucalyptii flourish best in a temperature ranging from 52 deg. to 72 deg. F. Eucalyptii as a rule attain the height of 160ft. to 200ft., but some have gone over 410ft., with a girth of 16ft. to 80ft. Mr. Draper, who visited the cultivation of eleven species at Tre Fontane, says: "Eucalyptus viminalis and eucalyptus botryoides do best in humid ground, whereas E. resimifera and E. meliodora flourish best in a dry soil; the globulus, however, will adapt itself well to all sorts of conditions." Mr. Bosisto classified eucalyptii in (1) amygdalina (peppermint-scented), (2) dumosa (or mallee), (3) globulus (blue gum), (4) Cucoxylon (iron bark), (5) obliqua (stringy bark), (6) odorata (sweet-smelling), (7) rostrata (red gum tree), and (8) viminalis (manna yielding). One hundred pounds of leaves of amygdalina supply seven fluid ounces of essential oil, while viminalis supply 500 fluid ounces. The important species of turpentine oil-giving coniferae are: (1) pinus maritima, (2) pinus pinaster, (3) pinus sylvestris, (4) pinus toeda, (5) pinus Australia, (6) pinus vulgaris, (7) pinus picea, (8) pinus rotunda, (9) pinus pumilio, (10) pinus abies, (11) abies pectinata, (12) abies balsamea, (13) abies excelsa D.C., (14) Larix Europea, (15) Larix Australis. The cone-bearing family is divided into (1) pines (abietinea), which include cedars; (2) firs (cupressinae), which include cypresses; and (3) larches (taxineae), which include the yews. Pines are comparable to the palms of the East with their slender stems and majestic heights. The roots of the pines can hold loose and sifting soil and

render it habitable and firm, and so are used for reclaiming desert land, as in the case of the Landes in France. Of the coniferae perhaps the hardest is the common larch (larix Europaea), which can grow on almost any soil, but which flourishes best at an altitude of 1,800ft. from sea-level. It attains a higher level even than the Scotch pine. Turpentine is the hygienic agent of the coniferae and camphor of lauraceous plants, from which is obtained the laurel or desotro-camphor.

The camphor tree, or laurus camphora, is indigenous in Japan, Java, Sumatra, and Borneo. The camphor tree of Japan, kusonoki, is a very hardy evergreen tree which attains enormous size though it is slow-growing. It flourishes in all sorts of conditions, and is so long-lived as to survive more than 300 centuries. In Borneo it is the kayo kapur reaching a height of 150ft., and having a very beautiful shape. The European representative of camphor tree is the Bay tree of "poet laureate" fame. The scent of camphor is unbearable to almost all insects, and so the hygienic effects of camphor trees are not only from hydrogen peroxide, but also on account of their fragrant emanations. Camphor laurel cannot bear the climate of northern Europe; in southern Europe, with great care it may live, but it flourishes best in India, China, Japan, and the islands of the Eastern Archipelago. The other camphor-supplying tree is dryobalanops camphora, whic his allied to the fragrant limes. It attains to about 90ft. without a single branch below that height.

Hind has its special fragrant tree, the sandalwood. As yet no special forestation of the san-

dal-wood tree is done to improve unhealthy situations, but its exceedingly fragrant nature and its oil with highly medicinal properties so much valued by the people of Hind are very hopeful features. Its hygienic influence is mainly obtained by the burning of its woods, and is used in fumigating houses and relgious places. No insect touches sandal-wood. Insignificant weed-like species of this tribe are to be found in Europe and North America. In East Indies and South Sea Islands they grow like shrubs or even small trees, but in Hind and Sunka (Ceylon) they flourish as large trees and grow wild in forests, especially on the Malabar Coast. There are the pterocarpus santalinus (or Red Sandal-wood), the two yellow sandal-wood species of the Sandwich Islands, hte fusanus of New Holland, Cervantesia tomentosa of Peru, and the Leptomeria billardieri of Tasmania. These sandal-wood trees are also hardy, and flourish in places where many other kinds of trees would not grow. It is probable that on account of the hygienic effects of these trees, other plants can exist in some thick-set jungles of Hind. In those tropical regions where on account of bad atmosphere most trees cannot grow, cinchona trees should be first tried. The quinine in cinchona is the means of the self-preservation of the trees against an infectious atmosphere. Cinchona is an evergreen plant and flourishes best at an altitude of 200ft. to 800ft. from sea level. There are twenty-six species. In the Andes they grow at varying elevations, and also between 11 deg. North and 20 deg. South. Cinchona belongs to the tribe of coffee plants. It seems only reasonable that in the district saffected with miasmic poison the cinchona trees having quinine

in them should be able to live, and so perhaps cinchona trees will be used in town-planning and soil-reclaiming at a future date, besides being laboratories of quinine manufacture. For reclaiming land by preventing the spread of sand-dunes, various kind of trees can be used. What pine has done for Landes can be repeated in other places. The planting of the first trees on sandy soil is no easy matter. The trees must be hardy and capable of bearing a salt atmosphere. For the tropics the best plant for this purpose is the palm tree. The desert palm is a very hardy tree of little wants, and can live in very unfavourable surroundings. In Ceylon the cocoanut palms are grown by planting the nuts in sand and seaweed or soft mud from the beach, and fresh water and manure are supplied. The young plants need to be protected from winds and beasts. On the coast of Malabar and Ceylon palms grow abundantly. The salt air is favourable for their growth, so that the finest plantations are always on the sea-shore. Trees also afford some protection against the sea. Mr. Rodway says : " Trees in the tropics not only grow on the shore, but extend for some distance into the shallows. The courida (avicennia nitida), the mangrove (rhizophora manglur), and several others are at home on the margin of the sea, and they form living dams more durable than the earthworks and fascines of the engineer." Mangrove trees can very well resist the effect of salt water, and so its progress is not impeded by anything. Generally mangrove is found in localities affected by miasma, but this does not prove that if they be grown under careful attention the atmosphere

will be vitiated. Thus with care they can be used for reclaiming land by the seaside.

It is well known that the banyan tree (ficus Indians) often begins life like a parasite on some other tree. So if the forest of mangrove or some other kinds of trees prove to be causing bad air, banyan seeds should be planted on them, as these may ultimately conquer the mangroves and replace them. The banyan tree throws out shoots that take root, and so it keeps on spreading. The wild fig tree is known to have done some work of destruction amongst its neighbours before it attains perfection. The pippul sends down true branches, not rootlets, which on reaching the ground take root. Banyan trees are never known to cause any bad effluvia, and so whenever possible they should be given a chance to replace other objectionable woods of trees. Mrs. R. Lee says, "The Banyan tree of India is the ficus Indicus which attains an almost incredible size; the girth of the trunk often is twenty-eight feet, but it seldom reaches more than sixty to eighty feet in height; its branches frequently extend over two acres horizontally, from the trunk, and send forth long, straight roots, which quickly fix themselves in the sail and form supports, like smooth pillars covered with silvery bark. The one tree forms a small wood. These are indeed trees that are helpful in reclaiming land, though there are others that also grow wild in the forests of the tropics. Besides reclamation there are other uses of mass planting from the town-planning point of view. When cold and strong winds have to be kept off, the planting of a grove of evergreens, spruce, pine, fir, palms, or bamboos will

serve very efficiently. These can grow in a grove and yet not hinder ventilation. This is not the only use of bamboo trees, as they are used also for road preservation. Mdmes M. and E. Kirby state: "Many of the roads in the mountainous parts of Jamaica are cert rock heights in a slanting and zig-zag direction. Lengths of bamboos are laid along the two edges of the road, and well covered with soil. The roots soon strike into the earth, and from every joint there springs a shoot. The young shoots form a thick green rampart on either side, and not only preserve the road, but beautify it as well. The cool, verdant arches form a delightful avenue under which the traveller may journey for miles together."

Pines and palms are best suited for the sides of hills, and may be planted close. Damp grounds are better suited for deciduous trees, and these should be planted rather open. Overcrowding of trees is at times the cause of disease. In winter the deciduous trees cannot evaporate the water round their roots, and so the roots die because the soil becomes sour. In most cases of mass plantation exposed to strong winds, the "tree-mothers," or screens, have to be planted to keep off cold and strong winds from the young plantations. Such screens should be of trees that grow quickly and are not of much value. Larch may be planted thickly. When their purpose is served they may be cut when still young, and sold for making poles. A thick plantation of banana trees can be grown very quickly if the soil is not altogether unfavourable. In ten months they can reach perfection and give splendid clusters of bananas. They with and die soon after

the clusters are gathered, but new shoots sent out may be well grown by that time. Thus they serve as screens and also as a source for the supply of nutritious fruit, requiring no more attention than clearing the weeds from their neighbourhood. There is one trouble about them, and that is their objectionable habit of spreading all around. This can be prevented by cutting a sufficiently deep trench between their plantation and the next. The trench may be filled with unfavourable material. However, the banana trees do not grow higher than 25ft., and on the average about 15ft. The trees to be protected may have grown sufficiently strong by the time they are 15ft. high; if not, supports may be given. A screen may be planted to also conceal an object of considerable extent. When two lines of plantations are grown, the following rules of Chevreul for the first line are worthy of attention :—

(1) "If the plants in the same line are not of the same species, it is essential that they do not differ too much from each other in respect to height."

(2) "Where a line happens to be entirely seen, the same species must be placed alternately."

(3) "We must avoid placing the same species in two neighbouring lines, when we would employ varied masses which are composed of several lines only."

The second line may be planted in the same way as the first, "except that the stakes indicating the centre of vegetation must be placed chequer-wise relatively to the centre of vegetation of the first line." There should be a distance of about 5ft. between these lines. According to Chevreul, to hide a wall the first line may

be of (*a*) almond-laurel, (*b*) violet-lilac, (*c*) laburnum, (*d*) violet-lilac, etc., and the second line of (*a*) clump of prunus mahaleb, (*b*) Idem, etc. If these rules are followed, the distant masses, though of varied foliage, appear to be always in harmony of form and colour. Where there are masses of deciduous trees a quantity of evergreen looks out of place in a large space. Collections of shrubs, bushes, underwood and flowering herbaceous plants are used to form thickets. To produce a grove, a collection of trees aided by shrubs, bushes and underwood should be planted. A park consists mostly of trees in a large space where small plants would get comparatively lost. Sometimes a thicker assemblage of trees is grown to make a wood. A wood that is very large and very thick-set becomes a forest. Woods and forests are desirable in the neighbourhood of towns for the study of nature in its true state, provided they do not breed beasts of prey, or are cleared of such beasts. In the words of Mr. Rodway : "The study of herbaria and cases of stuffed skins is no longer satisfactory; the naturalist must go to nature, and the student must have his field of investigation brought nearer to him."

TOWN PLANTING.

The reference to parks takes us into the heart of a town. In spite of all difficulties, trees may be grown and can flourish in towns, provided care is taken to choose the right kind and some attention is paid to them. The capital of British Guiana is an everlasting monument to the possibility of changing the sordid physiognomy of a mud flat, wanting in every element

of the picturesque, into a comfortable and even handsome-looking young town, by the careful growing of vegetation. It is not only the aesthetic side that demands vegetation, but also the scientific side of public health. Heath says: "Why will not people see that much of what they spend in poor rates might be saved by the introduction of more trees into towns? Trees are sanitary agents, more efficient and more persistent than public officers of health." Yet, as already stated, unless careful selection is made in planting trees in streets, they will not prove unmitigated blessings, because of their effect upon the surface of the road and the interference with daylight and with public artificial lighting. It is easy to see that those portons of road surface that are under the shade of the tsees do not dry as quickly as those that are unsheltered. These sections being comparatively softer than the ones dried hard, the wheels of vehicles cut deeper grooves. This goes on with every shower of rain, so that the road becomes a switchback bath. All this means increase in the cost of upkeep and in traction, and decrease in comfort. The best remedy is to pave the roads. In garden suburbs and villages, however, all roads need not be paved, and so in such cases no trees should be grown. The planting of trees on the outside of the curbing is not desirable. Mr. A. R. Sinnett says: "Trees are fatal to maintenance of proper road surface if this be of macadam or other modes of agglomeration, as carried out in prevalent practice. The practice of planting them towards the centre of the thoroughfare, namely, close to the curbing, is open to the following objections:—(*a*) It dwarfs the appearance

of the road, (*b*) seriously shuts out the view, (*c*) darkens the windows of houses and shops, (*d*) obstructs the free use of the footways, (*e*) necessitates the provision of expensive root-gratings, (*f*) it is unsightly for a number of years, until the trees mature, because of the necessity of enclosing them in guards, things utile nobody appears to have been able to treat artistically, and (*g*) lastly it creates the necessity for artificial watering.'' So in those places like garden cities where there is a chance for planning besides planting, the building line can be fixed on the rear part of the plot and the trees be planted not on the outside of the curb but on the inside of the boundary line. The planting of banyan trees on the side of the road is very undesirable in spite of the fact that they give good shelter, because even cement joints and sewers cannot keep out the roots in search of water. Only patent joints like those of Hassall and of Sutton can keep the roots out. Considering that the tamarind tree grows to large dimensions and gives very good shade, it can well replace the banyan tree.

Some regulation of the height of buildings on the sides of streets, and of the width of streets, is necessary even from the point of view of tree-planting. The greatest care is needed in selecting trees for boulevards in cities, because very few trees are suitable in every way. Some cannot endure the smoke and vitiated town atmosphere, and other sspread too much. For promenades and avenues the bushed should preferably be of '' close foliage and evergreen nature; laurustinus, enonymus, tamarisk and such like, might be employed. For streets, which it should be

sine qua non should be of open-armed and legere genre, in order to prevent destruction of the vista, arancaria, pinus austriaca, abius excelsa, and such like, might be planted." It is not accepted on all hands that evergreens are good for town-planning, because in towns they get covered with smoke and other kinds of dirt. One authority says, "Even our best landscape gardeners make a sad mistake by obstinately persisting in planting evergreens, which as a class are totally unfit for town cultivation. Even when moderately healthy these trees are generally so coated with smut that they entirely lack that polished and refreshing verdure which is so characteristic of evergreens grown in fresh and pure air." However, it might be said that plants are not protected from it, they will be well washed by the rain.

Again, there are towns which do not have much smoke in the atmosphere, and here the evergreen might well be grown. Evergreen foliage made sombre with smoke is better than no foliage at all. There are several shrubs and trees allied to the peaches, almonds, double-cherries, Indian pears, limbody trees, and kerries (mangoes), which flourish and attain perfect shapes in towns. Deciduous trees are well suited for town-planning in temperate and northern climes. As far as beauty and powers of bearing the town smoke are concerned, the best tree for towns of cold climates is the western plane (platanus occidentalis), and for warm climates the eastern plane (platanus orientalis), also known as sycamore, water-beech, button-wood, or cotton-tree. It is the favourite "umerdo" of the Hindi-men (Indians). However, there is one difficulty,

namely, that in the course of summer it throws off a thick down from the under surface of the leaves which often floats about in the air in unpleasant and injurious quantities. It is said by Mdmes. M. and E. Kirby that, "When the tree is very abundant, persons in the neighbourhood dread greatly the floating down, which irritates the lungs, and has a tendency to produce consumption." This indicates that it should be planted with moderation. It drops leaves that make a rich vegetable would which is good for young growing plants. It should not be planted on streets that are not open and require to be kept very tidy. It frees itself of parasites and moss by dropping its bark; this makes it possible for it to live in a town atmosphere, but it also makes its neighbourhood temporarily untidy. It is most suited for town gardens, squares and parks. One of its good properties is that large specimens can be safely transplanted.

The horse-chestnut, though indigenous to the North of Hind and North America, has been acclimatised in European countries, and has proved a good town tree, because even on hard ground and where the room for roots is scarce, it attains considerable size and good health. Nearly allied to this is the sugar maple which, though a native of North America, grows well in European countries. One tree which does not grow too large and keeps well in town air is the locust tree, or robinia, which is suitable for street planting. The Hindi Bor-tree is also one of fit dimensions for street planting, but is sure to collect a great many stones around it, as it is almost impossible

for Hindi schoolboys to pass a bor-tree without throwing stones in order to bring down its "bors," a fruit so dear to these boys. The babool of Hind is a species of acacia. It is a very hardy tree indeed, requiring no attention and growing even on dry, sandy soil. It has not much claim to beauty because, comparatively speaking, its foliage is scanty. Yet it grows to a convenient mean size and is suitable for street planting. Acacia, besides being hardy, has different species, and therefore is useful in all the continents of the world, and certain species have some claim to be considered of good appearance. The favourite street-planting tree of Europe is the lime, because of the delightful avenues that it will make, like the "Unter den Linden." The beauty of the pleasing soft green leaves of the lime is too short-lived to deserve so much popularity. In addition to this, limes, when planted in the front gardens of suburban villas, interfere much with the light and sun, and need a great deal of clipping. It is a good tree for the gardens at the back of houses and in parks and some large avenues, but not for narrow streets.

The elm is indigenous in Europe, but it beautifies the north of Asia, and the mountains of Hind (India), China, and North America. There are fifteen species of elm suitable for different climes and surroundings. It grows very well in town and, indeed, is the pride of the London parks and the Long Walk at Windsor. Mrs. R. Lee says, "Very lofty, very majestic, very graceful and altogether very beautiful, are Elm trees." Yet they are not well-behaved, for they possess so much activity that they are likely to squeeze out other trees from their neighbourhood, and for this reason it is not

advisable to plant other trees by their side. The roots, almost in the same way as those of the banyan trees, are difficult to check in their search for food. Like the banyan tree in kind, the elm in England has many superstitions woven round it. "The elms throw up suckers, which in their turn produce roots, so that the elm, as if aspiring to the dignity of the banyan, in some instances has been known to form a grove of itself." Amongst the many insects that attack it is the caterpillar of the goat-mother. These caterpillars throw off a disagreeable smell that is easily perceived by passers-by. On account of its very large size, too active roots, and this smell, the elm is not desirable as a street tree, but it is a splendid town tree for wide avenues and parks. Elm is about the hardiest tree and can bear transplanting of full-grown timber, which can be authenticated by the following words of Kirby. "By the system of transplanting elm trees which was successfully carried out, the most bare and barren places were converted into a rich scene of glade and woodland." In towns that are inclined to be very dusty and get a high temperature the paulavnia, the ailantus, and the plane will do well because they "seem to preserve a freshness and vigour no matter how great the heat and abundant the dust." For streets on bad soil and exposed to dust and draught the Lombardy poplar is suitable. It does not spread much and grows erect and close, which is a feature recommendable for street-planting if it is not overdone. Willows are very quick-growing trees and not difficult to plant. They grow well on marshy places and in sluggish streams, and so are recommended for planting by water-courses going

through towns. They will grow in all sorts of climates, both temperate and tropical. Willows are known to grow by the side of the glorious palms and comely bamboos, and also further north than any other ordinarily known plant. Though beauty in trees, as in persons, is a matter of opinion, yet the majority of people are agreed that the weeping willow is very beautiful in form, though coming after the Hindi palms, the Japanese sophora and tropical bamboos. Besides the weeping willow, the weeping birch, ash, beech, and elm, keep perfect health in town air and are very suitable for town parks.

The ash belongs to the olive family, growing and having value in the east and the west. It is a beautiful tree, but attains an inconvenient size for street-planting. Ash is subject to the ravages of cantharis, a golden-green beetle which gives off an unpleasant and sickening smell. When dead and dry, the insect turns to powder, emitting the smell in greater volume, and it is said, "It is impossible to pass the tree without inhaling the powder, which is most irritating and painful to the lungs; and the very face of the unlucky passer-by becomes inflamed as if bitten by gnats or other venomous insects." This is enough to put it out of the list of trees for street plantation and even in garden corners that may be protected from winds. To obtain a shady bower in a courtyard or a little square, the weeping elm of the lareg-leaved variety, the Japanese sophora (sophora japonica pendula) is the best suited for streets, as it does not grow too large or irregularly and, indeed, is very, very beautiful. It will thrive on poor, sandy soil, and no

matter how hot the season. This power of growing in dry conditions is especially useful for cities that may be called over-drained as far as the moisture for trees is concerned.

The hawthorn, for some reason or other, is not given as fair a chance as it deserves. For street planting it might do very well if the houses by the sides were bungalows with good compound, but where the houses open practically on the border of the street these dwarf trees interfere with the light. Anyhow, there are small squares and churchyards which hawthorns might adorn with their varied beauties of different species. There are the cotoneasters, the almonds, the peaches, double cherries and plums, amelanchiers, the bird cherry, the weeping cherry, the Judas tree, the quinces, the medlars, laburnums, daphnes, deutzias, lilac, pyrus, rose, acacia, and the Chinese pear that can be associated with the hawthorns. There is a long list of evergreens, shrubs, plants and trees which may be grown in town gardens and parks. In the tropics the question of tree-planting on streets is not so difficult. If the trees are such as give much shelter they are not objectionable because the light is at times glaring and the sun's heat is too powerful, so the trees do not interfere with light or warmth. Still they may obstruct the view in business streets which could better be planted with pretty groups of princely palms occasionally broken with suitable trees of spreading foliage.

In colder climates it is necessary that trees planted on streets should not interfere with the light and warmth of the houses situated almost on the verge of the streets, and that in winter when the green is most wanted they

should not present a dreary view of dead nature. Pines and similar trees, while not interfering with light, do not flourish well in town air, but they well deserve all the attention that is needed for growing even a few solitary specimens. Saphora Japonica is indeed the best for streets in cold climates. All fruit trees attract some birds or others, and it is an important feature to have birds in parks and gardens if such are to look really natural. Thorns such as cratoegus azarolus, c. aronia, c. crus-galli, c. coecinea, c. Douglasi, c. lee-ana, c. macrantha, c. nigra c. orientalis, c. obtusata, c. pyracantha, and c. fanacetifolia are those which attract most readily. These remarks about trees for parks, squares and streets will be incomplete if no reference is made to the oak tree. The oak indeed is the most stately of all temperate trees on account of its size, though it is not as large as some tropical trees. Oak grows in temperate climes mostly, but is also met with in the highlands of the tropics. It does very well as a park tree for towns, but for street-planting it is of too large dimensions. In planting trees in parks it is advisable to strive after a permanent arrangement and lasting beauty instead of annual display. This does not mean that the parks should be of such a nature that renders them monotonous because there is no change in the yearly display. There should be, as it were, a skeleton of choice, hardy trees giving immense superiority of permanent beauty over changing embellishments around which the annual display may be made to break the monotony. The skeleton work with hardy trees should be so effected that if no attention be given to these trees for about fifty years, they would not look

any the worse. This is easier said than done, unless special care be taken in selecting the right kinds of tree for teh surroundings and in the proper grouping of them. In colder climates the difficulty comes in trying to prevent a park from looking dreary in winter; for this purpose evergreens are indispensable. Though it is good to have a park as natural as possible, yet it is better to intersperse judiciously some artificiality. Artificial rock-work is a charming feature in park gardening. It is extremely desirable to have a belt of water in parks. It is a sad fact that although parks are provided for the people, yet in many cases no special precautions are taken for their sanitation. Dr. Bashmore says, "In these picnic parks and groves people come and go, yet there is practically more or less continuous habitation for three months at least, and unless we use the precautions which are recognised as necessary for such cases, it is likely that we shall find these parks to be an item in the public health." It often happens that parks are situated on the higher parts of a stream, while there is a regular habitation at the lower part. The picnicer often pollutes the water, and unless precautions are taken the inhabitants on the lower parts use the polluted water. The defence of the authorities generally is that flowing water has a power of self-purification, which though true to a certain extent, is not always a reliable fact. If no sanitary conveniences are provided or people are not stopped from urinating wherever they like, a good part of the filth, and so infection, is washed down into the water course by the first shower of rain. Dr. Bashmore says, "The proper closet for a picnic grove to have, no matter in

what part of the country it is situated, is a dry, water-tight, cemented pit, covered by a carefully-constructed privy, with a ventilating shaft of not less than eight inches in diameter, extending from the pit, on the outside of the house, to at least several feet above the roof; the seat should be provided with a lid so to exclude flies, and the whole arrangement should be properly screened by bushes or a trellis of vines, in order to insure the necessary privacy. The contents of the closet can be disposed of on some near-by field and composted by covering with earth, or it may be directly ploughed under for fertilizer; but such material should not be put on land where it is likely to be washed into streams." For the parks situated in towns having the water-carriage sewage system, water-closets are the best. Dr. Bashmore's advice is for country places where such systems are not established. An ideal dry method of urine disposal is suggested by Dr. Poore: "This method consists in simply making use of the nitrifying properties of the soil. Over a space about two feet wide and six or eight feet long, depending on the needs of the grove, the soil is turned up with a spade as in digging a garden-bed, and into this trench the urine is received; and here it is quckly and inoffensively destroyed by aeration and the nitrifying germs which are present everywhere in the upper soil layers. The urinals should be open on the top to let in sunlight." Woodwork is not desirable because it sucks in urine and gets saturated with it. The germs of typhoid in urine remain active for a considerable time after a typhoid fever patient has recovered, and so promis-

cuous urination should be prohibited, especially near water courses.

Small sellers should be prevented from exposing food to infection by dust blowing on it, because the dust may carry infection from the expectoration of diseased people. Good, comfortable, and sanitarily-managed refreshment places should be substituted for hte small seller; or small, clean stalls with sanitary supervision should be provided for them. Parks should not be too large, otherwise they become unmanageable and serve as harbours for undesirable people. This is one objection to keeping them open all night. A French author says, "Le parc rend à nos cités industrielles surpeuplées un service spirituel comparable à celui que la cathédrale dans la grandeur et la beauté de son architecture offrait à la population rurale du moyen âge. Le parc c'est la cathédrale de la ville moderne." Thus we see that vegetation plays an important part in town-planning from the point of view of the health of the public.

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